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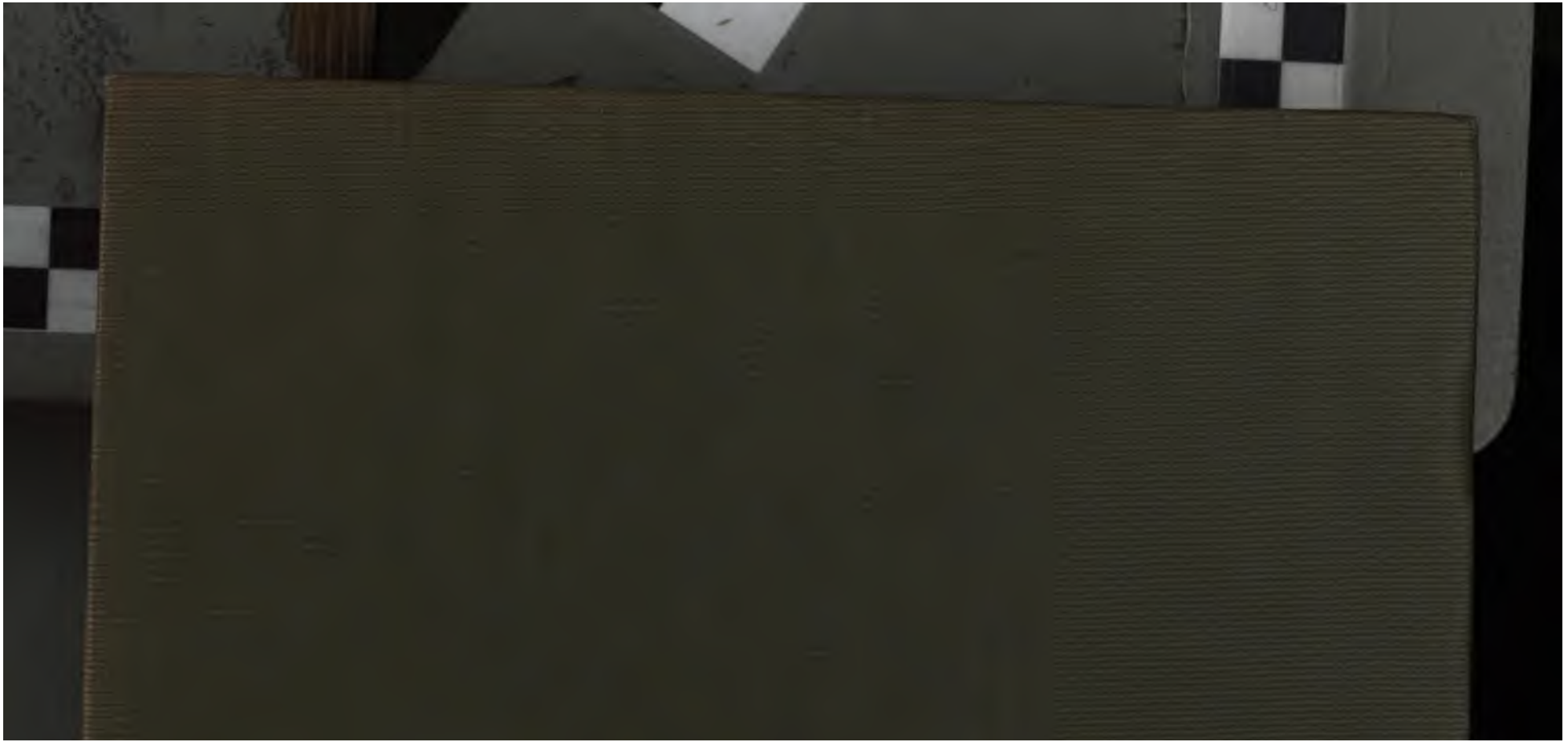

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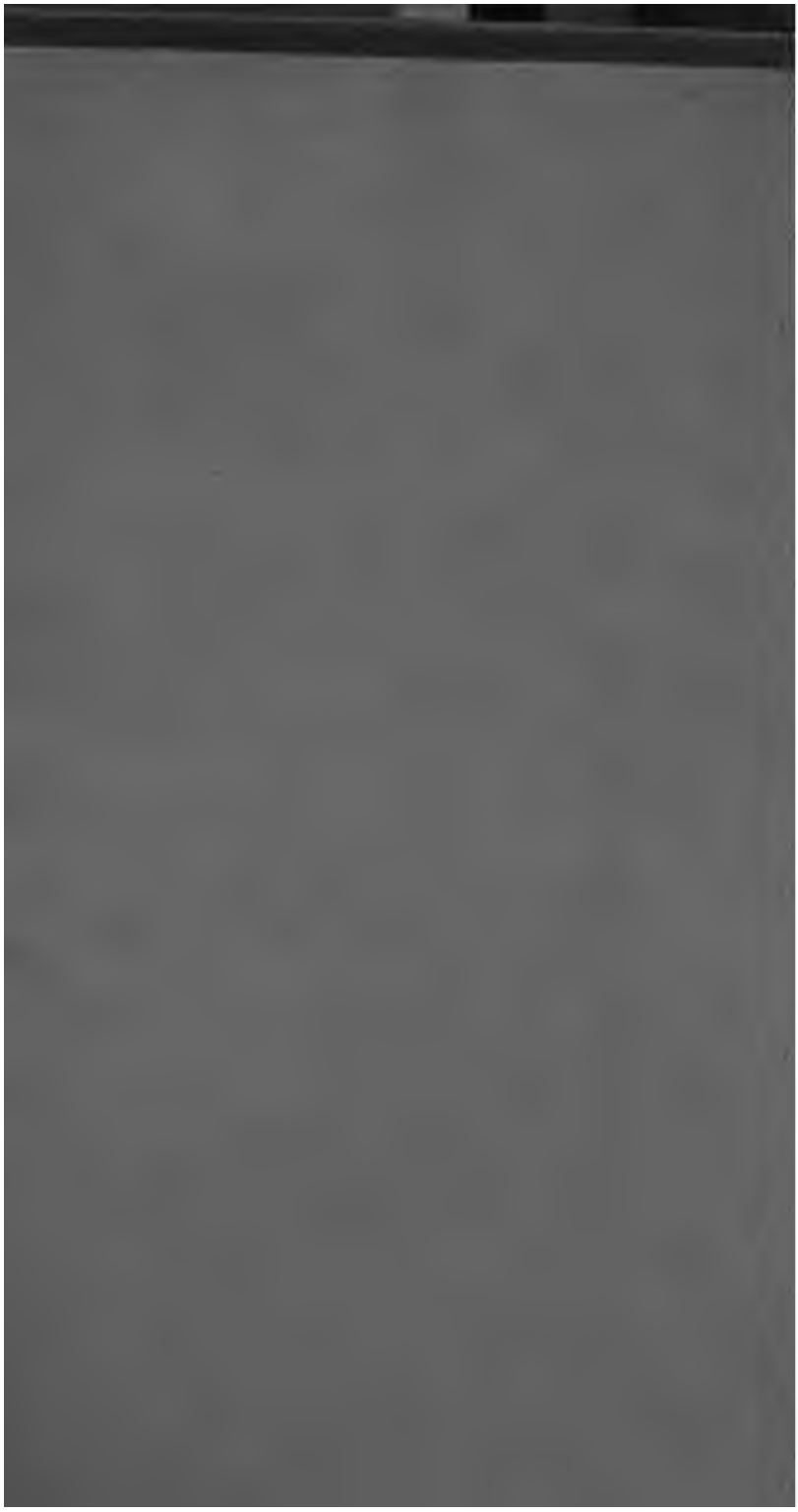

TASMANIA

REPORT

OF THE

SECRETARY FOR MINES

FOR

YEAR ENDING DECEMBER 31

1906

Including Reports of the Inspectors of Mines, Government Geologist, Mount Cameron Water-Race Board, &c.

Tasmania:
JOHN VAIL, GOVERNMENT PRINTER, HOBART

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REPORT OF THE SECRETARY FOR MINES.

Mines Department,
Hobart, 28th May, 1907.

SIR,

I HAVE the honour to submit my Report upon the Mines Department and the Mining Industry for the Year ending 31st December, 1906.

GENERAL REMARKS.

The aggregate value of the minerals and metals raised during the year was £2,257,147, being an increase of £528,018 on the value of the output for the preceding year.

This exceeds that of any previous year, and is partly owing to the increased price of metals and partly to the fact that there has been an all-round increase in the output of all minerals and metals, except gold, wolfram, and iron.

The number of leases issued during the year was 730, embracing an area of 19,912 acres, as against 512 leases, of 11,491 acres, during the previous year. The total area held under lease on the 31st December was 53,222 acres.

A sum of £823 was expended by the Public Works Department in opening up tracks and roads to mining districts.

The expenditure of money in opening up tracks to unexplored and almost inaccessible country would prove of great advantage to prospectors, and would doubtless be the means of inducing many parties and syndicates to

send out prospectors into new country. At present the hardships of prospecting are so great that few have the strength and courage to contend with them, and cut their way through dense horizontal scrub and carry their swags and provisions.

When tracks are cut by the Government they should be kept open, as the fallen trees, together with the rapid growth of the scrub (which in many parts during the winter months is capped with snow, and borne to the ground with its weight), not only block the tracks, but completely obliterate them.

A sum of £150 was placed upon the Public Works Schedule last year for clearing tracks, but the amount is insufficient, and should, I respectfully submit, be considerably increased this year.

Keeping these tracks open is of the utmost importance to prospectors, and the annual expenditure of a small sum of money for that purpose is fully justified by the rapid growth of the industry, and every encouragement should be given to prospectors, while the high price of minerals and metals is maintained, to search for and open up new fields.

Appendices.

Appended will be found the following Reports:—

Annual Report of the Mount Cameron Water-race Board.
Report of the Government Geologist.
The Report of the Chief Inspector of Mines.
Reports of the Inspectors of Mines.
The Government Geologist's Reports on:—
The Mathinna Goldfield: Part I.
Ditto: Part II.
The Cox's Bight Tinfield.
The Renison Bell Tinfield.

Gold-mining.

The total quantity of gold won during the year was 60,023·397 fine ounces, valued at £254,963.

Beaconsfield.—The yield from this district was 30,484 ounces of retorted gold; and the number of men employed was 693. At the Tasmania Gold Mine developmental work, which was proceeding apace, received a severe temporary check, owing to the flooding of the mine in June. On the 25th of that month the rainfall culminated in an unusually heavy downpour, causing an overflow of the deviation channel bank at Blythe Creek. The water overflowed from the channel to the old limestone quarries, and cut the surface soil away to such an extent that the channel banks gave way, and the whole of the water flowed into the quarries, cutting a channel 40 feet wide, and deepening the deviation channel by 4 feet. The whole of the flow disappeared in the bottom of the quarry, causing settlement over about 7 acres of ground. The construction of a dam across the 40-feet gap was at once started, but unfortunately was not successful, for on the 28th June the pressure of the water carried away the sheet piling and sand bags, and swept a large portion of them into the caves. A deviation channel and two dams were then started. All carpenters were set to work on the construction of fluming, the saw-milling plant being kept running day and night to supply the necessary planking. By the 7th July 900 feet of fluming, 14 feet wide and 9 feet deep, was completed, and the whole of the water turned into it. The total amount of water which flowed into the quarries was estimated at 820 million gallons, and the amount of soil at 240,000 tons, a total of 5 million cubic yards. The flow during the heaviest part of the flood was estimated at from 250 to 350 million gallons per day. The approach of water from the quarries was first felt in the mine twenty-three hours after the overflow of the deviation channel bank, by large volumes of CO_2 gas being forced before it. On the 7th July the water rose to the 846-feet level, where it remained stationary for twenty-four hours. On the 21st July it reached the 800-feet level. The highest point, viz., 796 feet 3 inches below the collar of the main shaft, was reached on the 30th July. The

pumps and bailing-tanks were raising about 5,700,000 gallons a day, and by the 2nd of September the water was reduced to the 816-feet level. The eastern unit at Grubb's shaft then started, and a week later about 8,100,000 gallons a day were being raised. On the 30th September the water was reduced to about the 970-feet level. The flood-gates at the 1100-feet and 1000-feet levels stood the heavy pressure very well, and enabled the pump in Grubb's shaft to be put in. At the main shaft the lower set of poles were under water for eleven and a half weeks (that shaft being too near the lode for flood-gates to be of any use), and this caused much anxiety, as the failure of any of the valves would have placed too great a pressure on the flood gates, and drowned the pump at Hart's shaft. The winding-engine at Hart's shaft and the steel head-gear which were made of exceptional strength, in case they should ever be required to deal with a burst of water, saved the situation.

Mining Operations.—1100-feet level. The necessary flood-gate having been built, the main crosscut was continued for 117 feet, cutting the lode at a point where it proved to be 9 feet wide, value 27 dwts. of gold per ton. No. 151 rise was started in hanging-wall stone as an escape pass, and holed to 1000-feet level in 107 feet, width taken 2½ feet, value 14¾ dwts. of gold per ton. Everything was ready for rapid development at this level when the flood occurred at Blythe's Creek on the 25th June, but nothing further could be done until about the middle of October, when the mine water was reduced to a normal condition. Mining operations were not fully resumed until the 3rd November. The 3rd unit of the company's magnificent pumping-plant was started on the 6th December, so that with the enormous pumping capacity now available it is improbable that any future burst of water would cause serious damage.

Shafts.—Grubb's shaft was sunk during the year 400 feet, to a depth of 1028 feet, which was reached on the 30th April. Sinking was again resumed early in Decem-

ber. It is now to be sunk to 1250 feet, and a crosscut extended from the bottom level to cut the lode. The two pit-work chambers at the 500-feet level have been finished, as well as those at the 1000-feet level. The balance-weight chambers at the 350-feet, 400-feet, and 800-feet levels (two each) have been completed, and the two remaining ones at 900 feet are nearing completion. The size of this shaft is 8 feet by 32 feet 1 inch in the clear; speed of sinking last 400 feet being 13⅓ feet per week. The large chambers at 500-feet and 1000-feet levels are, over all, 112 feet by 14 feet wide and 25 feet high. The total cement foundations placed in the various chambers was 3782 cubic yards. The timber from the surface to the 500-feet level is 15 inches square, and below that level 12 inches square, placed throughout in frame sets, 4-feet centres. In the two chambers at 350-feet level the ground proved too heavy for the timber, and had to be secured by concrete. The heavy pressure of the swelling ground above this level buckled a number of the frame sets, and broke some. The swelling has now ceased.

Hart's Shaft.—This shaft has been sunk a further depth of 31 feet; total, 1139 feet. At the 400-feet level two balance-bob chambers, each 37½ feet by 12½ feet by 28½ feet, have been completed; two chambers at 900-feet level have also been completed. The shaft has been enlarged from 1050-feet level to 1100-feet level, to make room for two 20-inch plungers. The water at 1100-feet level is at present held by one 14-inch bucket. The crosscut from 1100-feet level to Grubb's shaft has been completed, and is used when required as a water-way between the two shafts, also as a means of filling the stopes with material from Grubb's shaft.

The foundations for the 2nd and 3rd units of the pumping-plant have been completed and both engines erected, together with air-separators, condensers, and auxiliary engines.

The purchase of Wyett's tramway, 3 miles and 30 chains in length, with plant, was completed in December, 1905.

This tramway connects the mine with Beauty Point wharf. During nine months 18,802 tons have been carried, of which 554 tons were on account of the public. Mine development has been carried on vigorously at the different levels, footwall drives extended, flood-gate at 1100-feet level put in, air connections made, and the ventilation of the mine much improved.

The Bonanza Gold Mining Company had sunk its shaft to 600 feet in the early part of the year, since which time work below has been suspended, pending the erection of a steam-winding plant. When this is completed sinking operations will be resumed down to 1000 feet, at which level it is expected the continuation of the Tasmania reef will be cut.

North Tasmania Mine has been worked by a tribute party, with only moderate success.

Moonlight-cum-Wonder Mine.—Some trenching and costeening has been done, but nothing payable has been discovered.

Tasmanian Alluvial.—T. B. Williams and party. Tributers from Tasmania Company sunk a shaft 55 feet on Block 166, but have not so far met with any success, water being too heavy.

Tasmanian Tailings Syndicate has been running the cyanide plant consistently, and is getting fairly good returns.

East Tasmania Company is boring on its property for the Tasmania lode. The Australian Goldfields Diamond Drilling Company has the work in hand.

Lefroy.—No development of value has taken place during the past year. The New Pinafore Company has done a good deal of prospecting at Specimen Hill and other places, but without discovering anything payable.

The Nugget Prospecting Association, after considerable work, sinking and driving, failed to cut payable stone.

Tregurtha P.A. fixed up a small steam-winding plant to unwater an old shaft at what was once known as the New

Monarch Gold Mine, but its efforts were unavailing. A recent discovery made by Mr. George Barker near Back Creek has caused a move to be made in that direction.

Mount Victoria.—The Long Struggle Company, after getting a few small crushings, was eventually driven out by water. The company has recently sunk an underlay shaft 30 feet on another portion of the lode, and got a crushing out. The New Ringarooma Syndicate has not succeeded so far in getting capital into its mine, although the prospects are very encouraging. At the New River Freehold shaft sinking had to be suspended owing, it is said, to want of funds to erect a pumping-plant; the mine is now idle.

Mr. Williams' cyanide plant had a successful run for a time, until the tailings on his claim were used up. There are other heaps of tailings on the field which would probably pay to cyanide.

Mathinna.—Tasmania Consols: New steam-winding plant complete and air-compressor have been installed during the year. Poppet-head gear has been erected, and the equipment of the mine generally improved. The shaft has been sunk from the 1200 to the 1600 feet level, and crosscuts have been driven from the 1500-feet and 1600-feet levels respectively. Towards the end of the year Mr. R. A. Canning was appointed general manager.

New Golden Gate.—Work during the greater part of the year was confined to getting stone from small veins at two or three places in the old levels; also prospecting in the southern end, by extending a long crosscut east from No. 5 level, sinking a winze north of the crosscut at No. 17 (1600-feet) level, and driving south on the lode at the same place. No discovery of value was made at any of these places. The winze at the bottom level (No. 17) was sunk on a good body of stone carrying gold, payable for the first few feet but not so good as depth was attained. The question of sinking the main shaft to a greater depth, probably to 2000 feet, remained in abeyance for a long

time. Finances and other matters had to be adjusted before this work could be undertaken. It is, however, gratifying to know that all obstacles have been removed, and that the further sinking of the shaft below No. 17 was commenced early in December.

Volunteer Group.—Work at these mines has ceased altogether, save for the cyaniding of tailings at the Volunteer Mine, which has been carried on since the mine shut down a year ago. Work at the other two mines, Volunteer Consolidated and Volunteer Consolidated Extended, was discontinued in the latter half of the year.

Scott-Pickett Gold Mine Company.—The adit level was extended 84 feet south on the lode, and some stoping done. Main shaft was started, but proceedings had to be suspended owing to the influx of water. A small steam pump was put in, and sinking resumed at the close of the year.

Burns Creek Gold Mine, Blessington.—Work was discontinued for a time towards the close of the year, more capital being required. The prospects of the mine appear to warrant further expenditure.

Waterhouse Field.—Another trial is being given to the Prince Imperial Mine. Mr. John Wren, of Melbourne, has taken up a lease, and a mine manager has been appointed, and the work of unwatering the old shaft is now proceeding.

At Woody Hills the Murray Bros., and at Lynchford the May Gold Mining Company, have each crushed small quantities of quartz, for returns which have no way advanced the position of quartz mining on the West Coast.

Alluvial.—A limited number of men eke out an existence at Flannigan's Flat, Harris Reward, the Queen River and its tributaries, and at and around Darwin.

Silver-mining.

The past year has witnessed the firmer establishment of the Zeehan field as a mineral-producing centre. Very marked increases have taken place in the production of ores. The mines generally are in excellent condition, and

the stage of development at which they have arrived will enable them to raise larger quantities of ore, and at less cost than heretofore. The principal producing mines are the Mount Zeehan (Tas.), Zeehan-Montana, Zeehan-Western, Florence, Oonah, Silver Queen Extended, South Comstock, &c.; and at Mount Dundas, the Comet, West Comet, Ring Valley, Ring River, North Jupiter, Hercules, &c.; others are active, and give fair promise for the future.

The lowest level in the Zeehan-Montana Mine is now 800 feet deep. A more powerful winding-plant has been obtained from England for the deeper work.

The Zeehan-Western Mine shaft is sunk to 800 feet, and the lode at this depth, though not payable, has opened out to the width which it had in the profitable zone above the 300-feet level.

The main shaft at the Austral Valley Mine is being sunk, and it is intended to sink it to 300 feet, and then open out.

The Oonah Mine has been placed under option. The optionees have unwatered it, and are developing the stannite lodes with some degree of success.

The Mount Zeehan (Tas.) Mine has put out its usual product of high-grade galena.

Several galena lodes have been disclosed on the Queensberry property, with high percentages of lead and somewhat low silver contents. The property is being developed, and is said to have encouraging prospects.

Rosebery District.—Developmental work has proceeded on several properties, and upwards of 18,000 tons of zinc-lead ore have been consigned by the Tasmanian Copper and Primrose Companies. The Primrose Company has largely increased its holding, and has also acquired the old Mt. Black leases. The Colebrook Company is intending to erect copper-smelting furnace for its own ore, and anticipates a certain amount of custom work from other copper-producing mines in the vicinity.

Mount Read.—The Hercules Mine has been idle for the greater part of the year, but resumed work towards the end of the year, and the work soon disclosed larger reserves of ore than has been expected.

Work has been started at the North Jupiter Mine on a zinc-lead sulphide ore-body, carrying ore worth £5 or £6 per ton gross.

Farrell District.—The discovery of rich ore at the Mt. Farrell Mine has given a renewed impetus to prospecting on this field, which is in a valuable zone of silver-lead mineral.

The North Farrell Mining Company is steadily developing its mine, producing galena worth about £11 and £12 per ton at the mill. Preparations are being made for the construction of a steel tramway for the transport of the company's ore to the Emu Bay Railway line. A permanent water supply has been obtained from a lake on the summit of Mt. Farrell. This means a constant water supply for ore-dressing during the summer months.

The Murchison River Silver and Lead Company has opened up several thousand tons of ore ready for breaking. Several new companies are being formed to work properties in the Farrell district (White Hawk, South Murchison, Mountain Chief, &c.), and good results are expected from the prospecting which is now going on. There is little doubt that this is going to be an important field.

The Tasmanian Smelting Company has, during the year, purchased 47,754½ tons of ore from the surrounding mines, and exported 9380 tons of lead bullion, containing 1,449,386 ounces of silver and 3119 ounces of gold.

Magnet Silver Mine.—During the year 7787½ tons of silver-lead ore were won and consigned, of a gross value of £51,147. The No. 6 level has realised expectations fully, and opened up some of the best ore ever seen in the mine. The main underlay shaft has been deepened to No. 7,, where the crosscut intersected the two lodes, 15 feet

and 6 feet respectively, carrying large quantities of highly profitable ore. The ore-shoot in this mine has now been proved to exceed 1300 feet in length, and is improving in solidity as it goes down. The presumed two lodes cut in the lowest level have merged into one, the whole having a total width of 36 feet. This drive so far has shown the existence between it and the level above of 10,000 tons of ore. Assays of the galena range from 132 ozs. to 161 ozs. per ton. A high-level water scheme for driving all the mining and mill machinery is approaching completion. Dividends amounting to £8000 have been declared during the year.

Heazlewood.—Work at the Long Tunnel Silver-lead Mine is being resumed, and other properties, both copper and lead, are being again taken up in this district. A new copper lode has been found below the Bald Hill.

This promising field is apparently about to be taken in hand at more than one point.

Copper-mining.

The total quantity of copper and copper ore produced was 10,924½ tons, valued at £934,924.

The output of the Mount Lyell Mining and Railway Company, Limited, has been steadily maintained, the mine having produced 8708 tons of blister copper, containing 8613 tons of copper, valued at £772,183 3s. 10d.; 701,018 ounces of silver, valued at £90,260 13s. 0d.; and 21,866 ounces of gold, valued at £92,930 10s. 0d.—a total of £955,374 6s. 10d., being an increase of £147,060 on the previous year. The amount paid in dividends was £420,000.

Iron Blow.—In addition to the usual pyritic extraction, prospecting was continued south from "No. 8," on the contact, and the South Mount Lyell ore-body was connected with the main workings. Beyond this, however, nothing of importance was done, and having abundant quantities of similar grade, and more conveniently pro-

curable, ore in the open-cuts to draw upon, underground operations were suspended.

North Lyell and Lyell-Tharsis.—The usual quantities of high-grade and fluxing ores were obtained from these two open-cuts. Exploratory and developmental work was continued underground, with satisfactory results. The sinking of both shafts was continued, and high-grade ore, similar to that followed and mined from the surface, was intersected, which should provide further profitable stoping for the ensuing twelve months.

Royal and South Tharsis.—These mines have been connected by a 2-feet gauge tram with the main haulage system, in addition to being suitably mounted with the necessary hoisting gear on a railed incline or underlie shaft for providing and economically handling the silicious fluxing ores which abound on these properties.

North Crown Lyell.—Prospecting for over 1000 feet was continued on the "contact," without disclosing any development of importance.

Other outside sections have received attention.

At the Reduction Works five alternating furnaces comply with the mine's requirements, and dispose of a greater daily tonnage than that accomplished at any previous period of these operations. For power purposes, two 600 B.H.P. steam turbine generators have been installed, to which has been added a turbo-blower capable of supplying 18,000 cubic feet of air per minute under a 54-oz. (mercury) pressure.

Lyell Blocks Company.—The principal work in connection with the mine has been the driving of the Consols or main (No. 3) tunnel to a total of 2255 feet, and connecting with the main shaft at the 450-feet level, where preparations are being made to attack the cupriferous clays which have been located in this vicinity. Over this level continuous stoping was carried on, and 70,790 tons of cupriferous clay were treated, and yielded 824¼ tons of copper, valued at £65,422, out of which two dividends, amounting to £15,000, were paid to the shareholders.

Tasman-Comstock Consolidated.—During the year 20 tons of this mine's silicious ore were forwarded to London for special treatment, but the result has not yet been made known.

Prospectors Hyde and Siddler have reapplied for the old sections which formerly belonged to the Great Lyell South and Duke Lyell Companies, and bulk samples forwarded from both to the Mount Lyell Smelters gave satisfactory returns.

At Jukes and Darwin work has been intermittent. Mr. H. S. Muir has given attention to the Lake Jukes and Jukes Proprietary Mines, from which trial bulk samples have been forwarded to the Mount Lyell Smelters. An option has been taken over the section applied for in the name of George Hyde, known as the Hal Jukes Mine, which has been an inducement to others to take up abandoned sections in the vicinity, so that there is a probability of attention being renewed in this portion of the district.

At North Dundas the Ring River Company raised 1305 tons of copper ore, valued at £5838, and employed an average of 8 men.

Burnie Copper Mines.—Blythe River.—This was formerly the Copper King, which was worked on a small scale for one and a half years by Messrs. Clark and Sice, its discoverers. A main shaft is now being sunk to 160 feet. It is intended to open out at 150 feet, and crosscut to the lode 70 or 80 feet. The shaft is 14 feet x 4½ feet within timbers. Mr. Leigh J. Hancock reports:—A deep culvert has been made for the water 6 chains long in the basin of the mine. A road is constructed from the mine up to the main Blythe road for about 60 chains at a cost of about £400. The company has provided huts for the workmen, and settled them on its own freehold. Two substantial houses for manager and offices, &c., have been built. A small township, with post office, &c., is springing up. It is called at present Blythe Road, but the name Cuprona has been suggested. The shaft is being equipped

with winding-engine and a Root's blower for ventilating. During the year the mine produced 105¼ tons of copper, valued at £1220.

Tin.

During the year the London market price of tin steadily rose until, on the 14th May, it reached £215 per ton, which appears to be the highest price ever reached for this metal. The lowest price during the year was £161, and the average, calculated from the weekly cables from London, was £181 2s.

In some quarters it is stated that the high price of the metal is the outcome of market manipulation, but the more generally received opinion is that the immediate cause of the appreciation in the price is the increase in the consumption, coupled with the fact that there has been no corresponding expansion in production. There seems to be no doubt that the *bonâ fide* demand for manufacturing purposes has overtaken the production, and the world's consumption is steadily and rapidly growing. Hitherto the highest price for tin was in 1888, when it reached £170; but this was the effect of a corner, and was quite temporary.

The quantity of tin ore raised during the year was 4472¾ tons, valued at £557,266.

North-Eastern Mining Division.—The largest producer was the Briseis Tin Mines, Limited, the output from that mine being 1117 tons.

The Pioneer and Arba companies have worked persistently during the year, and with payable results. The Abbotsford Tin Mine is getting fairly good returns from old broken ground on Main Creek. A centrifugal gravel pump is being used.

The Moorina Tin Mining Company is using an elevator to lift the bottom or gutter wash, which is dipping to the north-west, or away from the Ringarooma River, into its tail-race. This mine, as well as many others in the dis-

trict, suffered a good deal of damage and loss (mainly to head-races, syphon columns, &c.) from floods during the exceptionally wet winter.

At the Mutual Hill Tin Mines preparations are being made for hydraulic sluicing on an extensive scale, and the Bell's Hill Mine is being reopened by a new company. The Tin Pot Creek Mine has worked with varying success; an additional 5 heads have been added to the battery, which is now a 15-head mill, and a Wilfley table has been added to the concentrating plant. There is a good deal of copper in the ore, and separating this from the tin increases the working expenses. The mine is worked by an open cut.

The Mussel Roe Tin Mining Company has constructed a head-race 21 miles in length, to bring water on to the mine. The intake is on the Mussel Roe River, just below the intake weir of the Mount Cameron Water-race, and several creeks are picked up, and brought into the main race.

The New Aberfoyle Tin Mining Company has in hand the construction of a long line of race, to bring water from the Boobyalla River, in the vicinity of White Rock, on to its mine, which is situated on the Ringarooma River about 4 miles from Boobyalla Port.

The North-Eastern Hydraulic Sluicing Company has installed a gravel pump and a 16 horse-power portable engine for elevating the wash. The original elevator had to depend on a continuous supply of water from the head-race to be effective, and, unfortunately, the supply from this source is only intermittent. There is a good supply of face-water from a large dam available, but there is not sufficient head-pressure for elevating.

Eastern Mining Division.—At Ben Lomond about 20 men are at work, in small parties, getting out tin and wolfram from some of the old Storey Creek Company's sections.

The Gipps Creek Mine is obtaining fairly good returns. At Briggs' Mine a limited output of about half a ton per

week is maintained. The Mount Rex Mine has, for the most part, been working on alluvial. Further prospecting at the No. 1 level in the mine has been done, and a drive has been extended about 100 feet south.

The Brookstead property is now being prospected by a South Australian syndicate, which holds an option over it. About 30 men are employed, and good results are, I understand, being obtained from both lode and alluvial.

North-East Dundas.—This district has come to the front lately, several deposits of tin-bearing alluvial and detritus being worked with marked success. There is reason to believe that the year's output has amounted to upwards of 80 tons of tin-ore, bringing up the total production since work was first started on the field to an estimated aggregate of about 240 tons.

At the Renison Bell Mine optionees have sluiced a surface deposit for over £3000 worth of ore. Several sluicing parties on various sections throughout the field have worked with highly satisfactory results. It now remains to open out work on the lode formations which exist in this metal-bearing belt. The Commonwealth tributes have turned out exceedingly well, the detritus being heavy and rich. Other sections with rich tin formations, both surface and lode, are Brumby's, Craze's, the Penzance, Sligo's, Kemp's, &c. A good track for the benefit of these mines has been constructed by the Public Works Department.

Mt. Heemskirk.—A moderate quantity of tin ore has been produced from this field, and recently some good discoveries have been made. It is becoming more and more apparent that this large tin-bearing mountain mass received very superficial prospecting in the early days.

Mt. Bischoff.—Dividends have been declared by the Mount Bischoff Tin Mining Company, Registered, during the year for £63,000, bringing the total up to £2,088,000.

The total quantity of tin ore produced by that mine to the end of December was 65,833 tons.

Somewhat disappointing results have attended the development of the mine, and towards the end of the year it was found necessary to reduce the output by 40 per cent. Measures are being taken to secure the utmost economy in working, and an exploration policy is being pursued with vigour.

The prospects of the Bischoff Extended (late West Bischoff) are far brighter than they have been for many years. Payable ore is being treated, and good development work is in progress.

Mount Balfour.—Tin mining has been prosecuted with vigour during the past year.

Whyte River.—A promising discovery of lode-tin has been made at the Whyte River, and the enterprise has been floated into a company, the Mount Cleveland. A small prospecting plant has been obtained to satisfactorily test the various lodes as they are intersected.

Cox's Bight.—This field is on the south coast of the island, near S.W. Cape, and alluvial mining is being carried on upon the flat terrace-land between the mountain ranges and the sea-shore. It has recently been examined by the Government Geologist, and his report thereon is appended hereto.

The tin ore has been shed from quartz veins in a spur of granite which descends to sea-level from the south end of the Bathurst Range. The Cox's Bight Tin Mines Company is hydraulicking the upper terrace drift, and has despatched for sale the last half-year 4¼ tons of ore, of an assay value varying from 73 to 75·2 per cent. metallic tin. Messrs. Weber, Gourlay, and Hawson are interested in several lagoon sections along the coast of the western bay, and it is contemplated to test these by bores. Messrs.

Pender and Atkins hold a section comprising the high granite spur between the two bays. Altogether, considerable interest is being taken in this district, which, since mining work was first started on it, is responsible for an output of about 120 tons of tin ore.

Iron.

The Tasmanian Iron Company was the only company engaged in mining operations during the year, and raised 2600 tons of hematite iron ore, employing 17 men.

Wolfram.

This mineral has been mined in the following localities:—

Ben Lomond, 15 tons 18 cwts. obtained; 9 men employed.

Story's Creek, 2 tons 15 cwts. obtained; 6 men employed.

Middlesex, 1 ton obtained; 3 men employed.

Coal.

The total quantity of coal raised during the year amounted to 52,895¾ tons, valued at £44,962.

The raisings at the respective collieries were as follows:—

Mine.	Tons.	Average No. of men employed.
Mt. Nicholas...	25,061	70
Cornwall	21,741	61
Dulverton...	294	4
Spreyton	1584	7
York Plains	393¾	2
Mt. Cygnet	1036	2
Catamaran	1303	4
Sandfly	1483	59

Antimony.

At Hall's Creek, near Rinadeena, Messrs. Kemp and Thomas are prospecting a show, from the surface outcrop of which exceptional samples of marketable ore have been obtained.

Diamonds.

A small diamond, $\frac{1}{8}$ of a carat, has been found recently at the Donaldson Range, in washing creek sand for gold. This is not the first discovery of this gem in Tasmania, as one was observed in some gem sand sent to England for examination many years ago by the Van Diemen's Land Co. The parcel of sand was from near the Hellyer River district. Again, in 1894, several diamonds were found in the Mt. Donaldson district, under circumstances similar to those in which the recent find was made, but their authenticity was doubted at the time. The largest seems to have been about $\frac{1}{3}$rd of a carat. The locality of parent rock of the gems is unknown, and so little is known as yet respecting the actual discovery that it is impossible to say what it may result in, but it may be accepted as next to certain that there are more to be found, some of which are likely to be larger than the small specimens known hitherto.

The following return shows the quantity and value of mineral products for the State of Tasmania during the year ending 31st December, 1906:—

Mineral.	Quantity.	Value.
		£
Gold	60,023·397 ozs. (fine)	254,963
Silver Lead Ore	87,117¾ tons	462,443
Blister Copper	8708 ,,	862,444*
Copper Ore and Copper	2234½ ,,	72,480
Tin Ore	4472¾ ,,	557,266
Iron Ore	2600 ,,	1100
Coal	52,895¾ ,,	44,962
Wolfram	19¾ ,,	1465
Bismuth	6 cwts.	24
		£2,257,147

* Value of Gold contents deducted.

The amount paid in dividends was £636,409.

Geological Branch.

During the year the Government Geologist has prepared reports upon the coal at Mt. Rex, and on the North-West Coast mineral deposits. He has also prepared quarterly reports on the mining industry of the State, and was also engaged examining the Mathinna Goldfield. The quarterly progress reports of the mineral industry have been issued, as usual. For these, as well as for the special district reports, there is a considerable demand from abroad, and from visitors arriving in the State. Our publications lying upon the tables of public libraries and institutes throughout the world may be regarded as of distinct service in directing the attention of investors to the mineral resources of Tasmania.

Inspection of Mines.

The three Inspectors have satisfactorily discharged their duties in the districts severally allotted to them. Their reports are appended.

Mining Managers' Examination.

The annual examination of candidates for mining managers' certificates was held in March. Three candidates only presented themselves for examination, two of whom succeeded in obtaining sufficient marks to entitle them to receive second-class certificates.

Copies of the papers set at the examination are appended.

Interstate Conference of Boards of Examiners of Mining Managers.

It has always been the practice of the Board in this State to issue certificates to persons taking up their residence in Tasmania upon production of equivalent certificates granted by the Boards of the other States.

Some of the other States reciprocated in the same way, and in order that a system might be adopted, a conference of delegates representing all the States except Western Australia met in Melbourne on the 23rd March, 1906, and

passed the following resolutions for submission to the Boards of each State:—

1. That the conference deal only with metalliferous mines, some delegates not having power to go further.

2. That it is advisable that the holders of mining managers' certificates issued in any one State be (on payment of a moderate fee) registered as the holder of a certificate of equal grade in the other States in which they take up their residence.

3. That on any State advising the Boards of Examiners in the other States that arrangements have been made to adopt the resolutions which this conference will submit, the holders of certificates then issued, and the holders of certificates which may be subsequently issued in that State, will be registered as the holders of certificates of equal grade in the States so advised. In the event of any State being unable to adopt any resolution of the conference, the other States should be advised.

4. That this conference affirms that it is desirable that all managers of metalliferous mines in which more than twenty men are employed underground should be compelled to hold a certificate, either of service or competency.

5. That this conference is of opinion that the service certificates of one State should be registered in the other States, provided that the qualifications required for the granting of the certificates are similar.

6. That in the case of certificates of competency, only first-class shall be recognised for the purposes of reciprocity.

7. That the certificates of competency as mining manager issued by the State of New South Wales under the Mines Inspection Act, 1901, shall be regarded as first-class for the purposes of the previous motion.

8. That no certificate of competency be issued to any candidate under the age of 21 years.

9. That all candidates for certificates of competency shall have at least three years' practical experience.

10. That the conference recommend the Boards of Examiners for the various States to grant a certificate of competency to any person who shall produce a certificate of having passed the requisite examinations from and under the seal of any School of Mines or educational institution whose curriculum, training, and subjects for and mode of examination are approved of by any of the Boards of Examiners.

11. That the syllabus of subjects be agreed to.

12. That a separate examination be set in each heading of the syllabus which has been agreed to, and that the

total length of the examination be not less than six sittings of three hours each. Also, that the time allowed for the examination on the subjects of mining, blasting, and ventilation be not less than six hours.

13. That for the purposes of reciprocity, the experience, within or without the State, necessary in applying for a certificate of service shall be three years as manager of mines employing on an average twenty men underground, provided that the whole or portion of the experience be obtained within a period of five years prior to the passing of the Act.

14. That the Mines Department of each State should publish in its annual report the names of candidates who have received certificates, or who have been registered in each year, and that each State should receive advice from the other States of certificates issued.

15. That a copy of the resolutions and minutes be forwarded to the Minister for Mines for Victoria, with a request that copies be sent to all the States of the Commonwealth, with the recommendation of the conference that the resolutions be adopted. Also, that copies be sent to each member of the conference.

These resolutions were subsequently submitted to the Board of Examiners, and after due consideration were agreed to, as follows:—

Resolution No. 1.—Agreed to.

Resolution No. 2.—Agreed to, with the substitution of the words "equal value" in lieu of "equal grade."

Resolution No. 3.—Ditto, ditto.

Resolution No. 4.—Not agreed to, as it was considered outside the province of the Board's powers and duties.

Resolution No. 5.—Agreed to.

Resolution No. 6.—Agreed that only certificates of equal value should be recognised for the purpose of reciprocity.

Resolution No. 7.—Not agreed to, as one year's practical experience is not considered sufficient.

Resolution No. 8.—Agreed to.

Resolution No. 9.—Ditto.

Resolution No. 10.—Agreed to, provided candidates have had three years' practical experience.

Resolution No. 11.—Agreed to, subject to further elaboration.

Resolution No. 12.—Agreed to.

Resolution No. 13.—Ditto.
Resolution No. 14.—Ditto.
Resolution No. 15.—Ditto.

Appended will be found a list of persons to whom certificates of competency have been granted since the inception of the Board.

The list is published in accordance with Resolution 14.

Diamond-drills.

The diamond-drills were not in operation during the period under review.

Mount Cameron Water-race.

The report of the Board is appended.

Departmental Staff.

The only changes which took place in the staff during the year were the appointment of Mr. J. Lonergan as Registrar of Mines at Waratah, *vice* Mr. J. Donohue, and the temporary employment of Miss Rotha Higgs as Clerk and Typiste to the Government Geologist, during the absence of Mr. F. S. Grove, whose services are on loan to the Mt. Cameron Water-race Board.

Revenue.

The net revenue for the year amounted to £24,136 12s. 5d., being an increase of £3927 15s. 5d. on the previous year. This amount does not include the sum of £6023 9s. 5d. deposited as survey fees with applications for leases.

Conclusion.

In conclusion, I desire to thank the officers of the Departmental staff for the loyal and efficient manner in which they have performed the duties allotted to them.

I have the honour to be,
Sir,
Your most obedient Servant,

W. H. WALLACE, Secretary for Mines.

The Hon. Donald Campbell Urquhart,
Minister for Mines.

DIAMOND-DRILLS.

Statement of Work done to 31st December, 1906.

Year.	Locality.	Direction of Bore.	No. of Bores.	Total Distance Bored.	Average cost per foot, inclusive of Labour and Fuel.
	No. 1 Drill.			feet.	£ s. d.
1882-3	Back Creek—For Gold	Vertical	7	1330	0 10 9
1883	Lefroy—For Gold	Ditto	4	1011	0 5 3
1884	Tarleton—For Coal	Ditto	1	401	0 5 6
1886	Longford—For Coal	Ditto	2	1585	0 4 0½
1886-7	Harefield Estate—For Coal	Ditto	1	725	0 6 5
1887	Cardiff Claim, Mount Malcolm—For Coal	Ditto	1	562	0 17 11¾
1888	Killymoon Estate—For Coal	Ditto	1	504	0 4 7¾
1888-9	Seymour—For Coal	Ditto	5	2266	0 7 8½
1889 / 1890	Beaconsfield (Phœnix G.M. Co.)—For Gold	Ditto	1	781	2 0 2
1890	Beaconsfield (East Tasmania G.M. Co.)—For Gold	Ditto	1	978	0 14 9½
1891	Spring Bay—For Coal	Ditto	4	937	0 6 10
1891	Ravensdale—For Coal	Ditto	1	114	0 11 1½
1891-2	Back River, Prosser's Plains—For Coal	Ditto	2	854	0 6 1¾
1892-3	Lefroy (Deep Lead Syndicate)—For Gold	Ditto	4	979	0 15 9
1893	Lefroy (East Pinafore Co.)—For Gold	Ditto	1	317	0 10 3
1895-6	Sandfly—For Coal	Ditto	4	2130	0 11 5
1898 / 1900	Blue Tier (Anchor Co.)—For Tin	Ditto	9	876½	0 9 1¾
1901-2	Llandaff—For Coal	Ditto	3	1944	0 7 4
1902	Recherche (Catamaran Co.)—For Coal	Ditto	2	956	0 9 3
1903	Ditto (Moss Glen Co.)—For Coal	Ditto	2	667	0 7 6
	Total	...	54	19,917½	

	No. 2 Drill.				
1882	Beaconsfield—For Gold ...	Horizontal, underground	1	68	No record.
1883	Mangana—For Gold ...	Ditto	1	546	0 15 1
1884	Guy Fawkes Gully, near Hobart For Coal...	Vertical	1	612	0 5 6
1885	Malahide Estate, near Fingal—For Gold ...	Ditto	5	1397	0 5 6
1886	Carr Villa, near Launceston For Coal ...	Ditto	1	571	0 5 4
1886-7	Waratah (Mount Bischoff Alluvial T.M. Co.) For Tin ...	Ditto	7	1548	0 6 1½
1887	Waratah (Mount Bischoff T M. Co.)—For Tin ...	Ditto	7	841	0 11 8
1887	Ditto ...	Horizontal, underground	1	53	0 7 8
1888	Old Beach—For Coal ...	Vertical	1	593	Abt. 0 10 9
1888	Campania—For Coal ...	Ditto	1	600	0 7 7½
1888	Richmond For Coal ...	Ditto	1	500	0 5 1¾
1889	Back Creek—For Gold ...	Ditto	4	787	0 8 5½
1891	Macquarie Plains—For Coal...	Ditto	2	989	0 4 5½
1891	Jerusalem—For Coal ...	Ditto	1	344	0 4 9½
1892	Langloh Park For Coal ...	Ditto	4	1249	0 5 3½
1893	Southport—For Coal ...	Ditto	1	612	0 5 3
1894	Zeehan (Tasmania Crown S.M. Co.)—For Silver ...	Horizontal, underground	2	319	1 0 2½
1902	Eden—For Coal ...	Vertical	2	566	1 0 7½
1902-3	Farm Cove—For Coal ...	Ditto	1	571	0 5 6
	Total ...	...	44	12,766	

Aggregate number of bores ... 98
Total Distance bored ... 32,683½ feet.

W. H. WALLACE, Secretary for Mines.

No. 1.

RETURN showing the Quantity and Value of Gold won during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, *and* 1906.

Year.	Quantity.		Value.
	ozs.	dwts.	£
1880	52,595	0	201,297
1881	56,693	0	216,901
1882	49,122	6	187,337
1883	46,577	10	176,442
1884	42,339	19	160,404
1885	41,240	19	155,309
1886	31,014	10	117,250
1887	42,609	3	158,533
1888	39,610	19	147,154
1889	32,332	13	119,703
1890	20,510	0	75,888
1891	38,789	0	145,459
1892	42,378	0	158,917
1893	37,687	0	141,326
1894	57,873	0	217,024
1895	54,964	0	206,115
1896	62,591	0	237,574
1897	77,131	0	296,660
1898	74,233	0	291,496
1899	83,992	0	327,545
1900	81,175	0	316,220
1901	*69,491	0	295,176
1902	*70,996	0	301,573
1903	*59,891	0	254,403
1904	*65,921	0	280,015
1905	*73,540	10	312,380
1906	*60,023	8	254,963
	1,465,321	17	5,753,064

* Fine Gold.

Diagram showing Total Quantity & Value of Gold won in Tasmania during the years 1880-1906

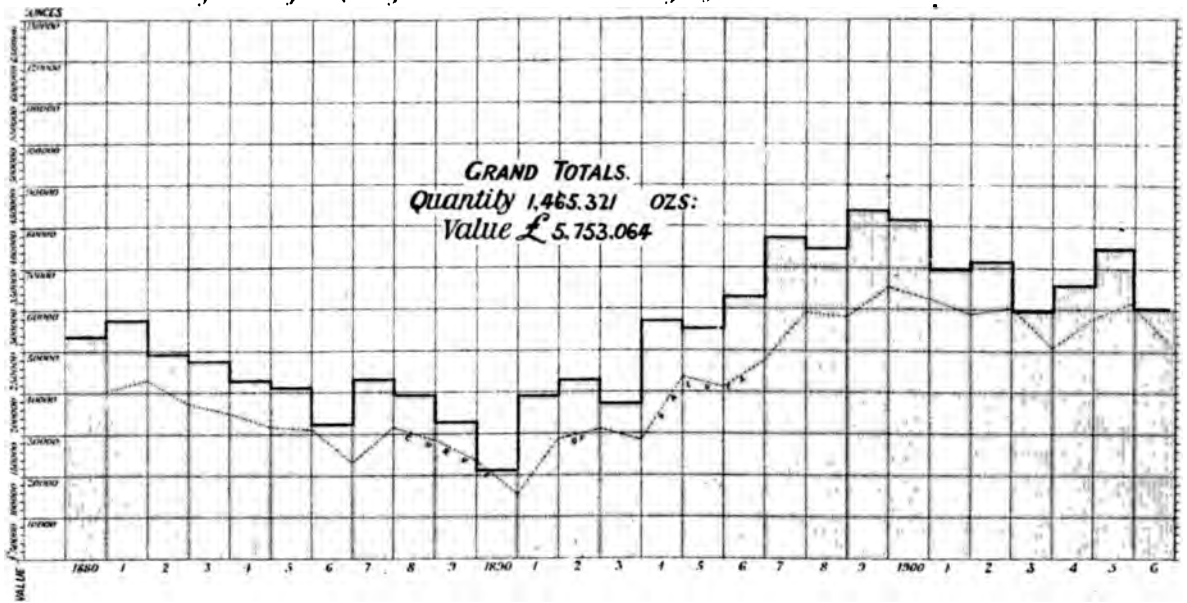
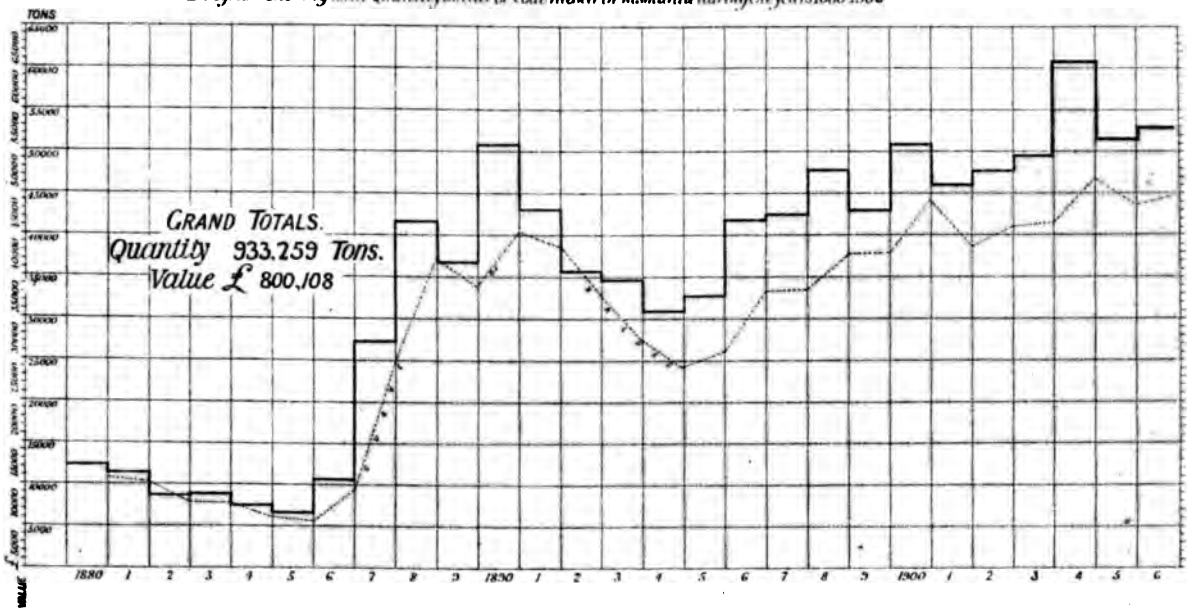


Photo-zincographed by John Vail Government Printer Hobart Tasmania

Diagram showing Total Quantity & Value of Coal raised in Tasmania during the years 1880-1906



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No. 2.

RETURN showing the Quantity and Value of Coal raised during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, *and* 1906.

Year.	Quantity.	Value.
	Tons.	£
1880	12,219	10,998
1881	11,163	10,047
1882	8803	7923
1883	8872	7985
1884	7194	6475
1885	6654	5989
1886	10,391	9352
1887	27,633	24,870
1888	41,577	37,420
1889	36,700	33,030
1890	50,519	45,467
1891	43,256	38,930
1892	36,008	32,407
1893	34,693	27,754
1894	30,499	24,399
1895	32,698	26,159
1896	41,904	33,523
1897	42,196	33,757
1898	47,678	38,256
1899	42,609	38,349
1900	50,633	44,227
1901	45,438	38,451
1902	48,863½	41,533
1903	49,069	41,709
1904	61,109	51,942
1905	51,993	44,194
1906	52,895¼	44,962
	933,259¼	800,108

No. 3.

RETURN showing the Quantity and Value of Tin exported from Tasmania during the Years 1880, 1881. 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, *and* 1904, *compiled from Customs Returns only, and Tin Ore produced during the Years* 1905 *and* 1906.

Year.	Quantity.	Value.
	Tons.	£
1880	3954	341,736
1881	4124	375,775
1882	3670	361.046
1883	4122	376,446
1884	3707	301,423
1885	4242	357,587
1886	3776	363,364
1887	3607½	409,853
1888	3775¼	426.321
1889	3764	344,941
1890	3209¼	296,368
1891	3235	291,715
1892	3174	290,083
1893	3128½	260,219
1894	2934	198.298
1895	2726¾	167,461
1896	2700	159,036
1897	2423½	149,994
1898	1972	142.046
1899	2239¼	278,323
1900	2029	269,833
1901	1789½	212,542
1902	1958¼	237,828
1903	2376$\frac{3}{10}$	300,098
1904	2171½	255,228
1905*	3891½	362,670
1906*	4472¾	557,266
	85,172$\frac{13}{20}$	8,087,500

* Tin Ore produced : Customs having ceased to issue Returns.

Diagram showing Total Quantity & Value of Tin exported from Tasmania during the years 1880-1904 and Tin ore produced during the years 1905 and 1906

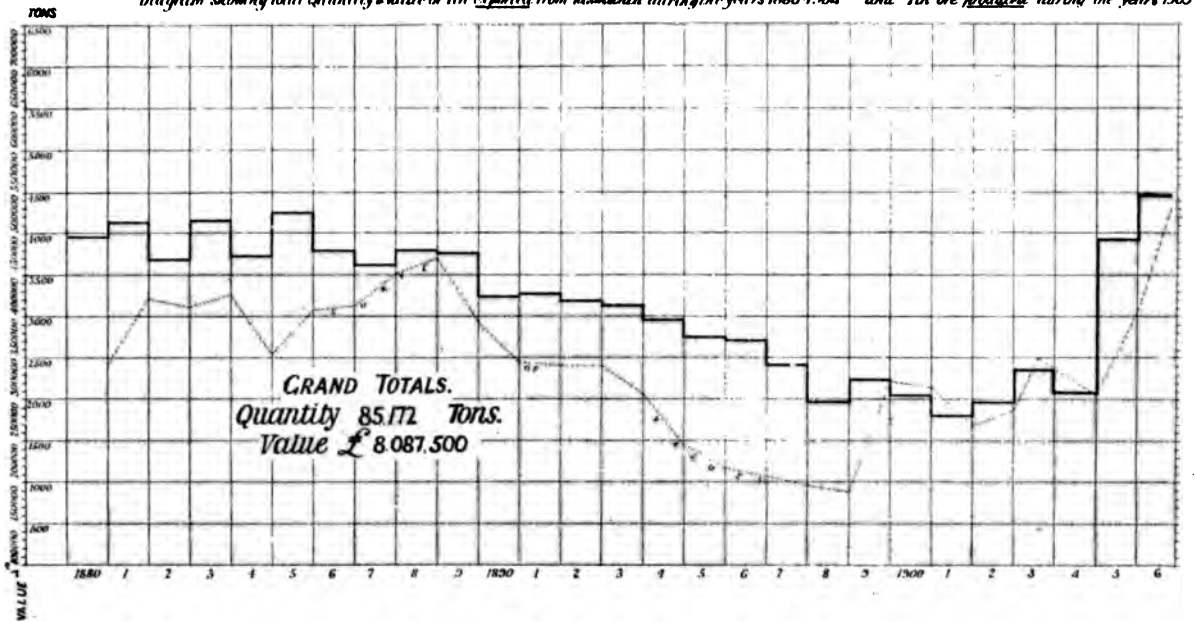


Photo-algraphed by John Vail Government Printer Hobart Tasmania.

No. 4.

RETURN showing the Quantity and Value of Silver Ore produced during the Years 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, *and* 1906.

Year.	Quantity.	Value.
	Tons.	£
1888	417	5838
1889	415	7044
1890	2053	26,487
1891	4810	52,284
1892	9326	45,502
1893	14,302	198,610
1894	21,064	293,043
1895	17,980	175,957
1896	21,167	229,660
1897	18,364	200,167
1898	15,320	188,892
1899	31,519½	250,331
1900	26,564	279,372
1901	28,774	207,228
1902	46,480	218,864
1903	42,422	192,492
1904	51,138	203,702
1905	75,270½	246,888
1906	87,117¼	462,443
	514,503¾	3,484,804

No. 5.

RETURN showing the Quantity and Value of Blister Copper produced during the Years 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, *and* 1906.

Year.	Quantity.	Value.
	Tons.	£
1896	41½	1245
1897	4700	322,500
1898	4955½	400,668
1899	8598	735,305
1900	9449	907,288
1901	9981	879,625
1902	7745	*462,151
1903	6684	*478,023
1904	8371	*582,540
1905	8610	*704,287
1906	8708	*862,444
	77,843	6,336,076

* Value of Gold contained deducted.

No. 6.

RETURN showing Quantity and Value of Copper Matte exported during the Years 1902, 1903, 1904 1905, *and* 1906.

Year.	Quantity.	Value.
	Tons.	£
1902	2500	50,112
1903	3727	83,624
1904	—	—
1905	—	—
1906	—	—
	6227	133,736

No. 7.

RETURN showing the Quantity and Value of Copper Ore produced during the Years 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, *and* 1906.

Year.	Quantity.	Value.
	Tons.	£
1896	34	1020
1897	75	2250
1898	394	8128
1899	1695	26,833
1900	4221½	63,589
1901	11,221	130,412
1902	5994	65,270
1903	102	790
1904	104	1640
1905	1150¾	52,939
1906	2234½	72,480
	27,225¾	425,351

No. 8.

RETURN showing the Quantity and Value of Iron Ore produced during the Years 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, *and* 1906.

Year.	Quantity.	Value.
	Tons.	£
1897	894	812
1898	1598	1598
1899	3577	3474
1900	5375	5995
1901	612	417
1902	2386	1075
1903	5980	2905
1904	6840	2975
1905	6300	2600
1906	2600	1100
	36,162	22,951

No. 9.

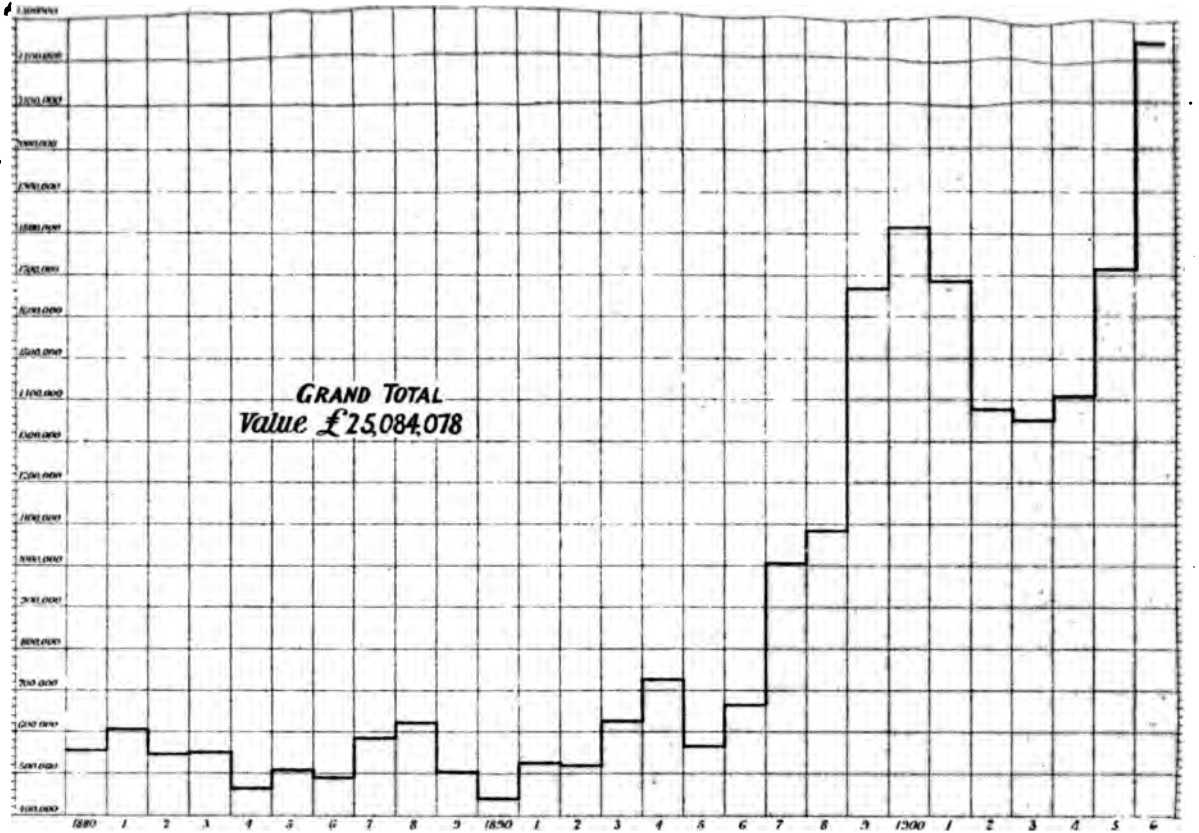
RETURN showing the Quantity and Value of Asbestos produced during the Years 1899, 1900, 1901, 1902, 1903, 1904, 1905, *and* 1906.

Year.	Quantity.	Value.
	Tons.	£
1899	200	363
1900	128	113
1901	46½	45
1902	—	—
1903	—	—
1904	—	—
1905	—	—
1906	—	—
	374½	521

No. 10.

RETURN showing the Quantity and Value of Wolfram produced during the Years 1899, 1900, 1901, 1902, 1903, 1904, 1905, *and* 1906.

Year.	Quantity.	Value.
	Tons.	£
1899	3½	99
1900	53¾	2058
1901	—	—
1902	—	—
1903	—	—
1904	15½	1147
1905	32½	2371
1906	19¾	1465
	124¾	7140


GRAND TOTAL
Value £25,084,078
1880
1
2
3
4
5
6
7
8
9
1850
1
2
3
4
5
6
7
8
9
1900
1
2
3
4
5
6

No. 11.

RETURN showing the Quantity and Value of Bismuth produced during the Years 1904, 1905, *and* 1906.

Year.	Quantity.	Value.
		£
1904	6 cwt.	15
1905	3½ tons	800
1906	6 cwt.	24
	$4\frac{1}{10}$ tons	839

No. 12.

RETURN showing the Quantity of Silver-Lead and Copper Ore smelted for period 25*th June to* 31*st December*, 1896, *and* 1*st January* 1897, *to* 31*st December*, 1905.

Year.	Ore Smelted.	Products.			Yield.			
		Silver-Lead Bull'n.	Blister Copper.	Matte.	Copper.	Silver.	Gold	Lead.
	Tons.	Tons.	Tons.	Tons.	Tons.	Ozs.	Ozs.	Tons.
1896	$26,028\frac{13}{20}$	—	—	$2417\frac{6}{20}$	$1235\frac{1}{20}$	75,951	4707	—
1897	$90,773\frac{1}{2}$	—	$3476\frac{12}{20}$	$257\frac{16}{20}$	$3583\frac{14}{20}$	334,349	16,485	—
1898	170,933	—	4992	—	4783	606,123	24,418	—
1899	275,239	2295	8463	$89\frac{8}{20}$	8362	1,089,657	27,61[illegible]	—
1900	363,113	4817	9449	—	9341	1,215,036	26,255	—
1901	355,528	1839	9082	50	9880	800,317	21,717	—
1902	411,736	6825	7727	2882	8841	1,674,816	24,719	6654
1903	399,032	7560	6683	3413	8094	1,855,158	25,238	7529
1904	433,366	—	8371	—	8265	1,896,134	26,809	7754
1905	466,578	9422	8611	—	8596	2,075,431	26,469	9086
1906	479,775	9380	8768	—	8613	2,150,405	24,986	9300

No. 13.

RETURN showing the Average Number of Persons engaged in Mining during the Years 1880 *to* 1906 *inclusive.*

Year.	Number.	Year.	Number.
1880	1653	1894	3433
1881	3156	1895	4062
1882	4098	1896	4350
1883	3818	1897	4510
1884	2972	1898	6052
1885	2783	1899	6622
1886	2681	1900	7023
1887	3361	1901	6923
1888	2989	1902	5934
1889	3141	1903	6017
1890	2868	1904	6194
1891	3219	1905	6581
1892	3295	1906	7005
1893	3403		

No. 14.

RETURN showing the Number and Area of Leases held under "The Mining Act, 1900," in force on 30th June in Years 1900 to 1903 inclusive, and on 31st December, 1903, 1904, 1905, and 1906.

Nature of Lease.	In force on 30th June, 1900.		In force on 30th June, 1901.		In force on 30th June, 1902.		In force on 30th June, 1903.		In force on 31st December, 1903.		In force on 31st December, 1904.		In force on 31st December, 1905.		In force on 31st December, 1906.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.
		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.
For Minerals, Silver, Tin, &c.	1487	70,500	1388	60,865	1063	45,399	950	40,068	826	33,325	868	33,824	944	34,325	1307	43,036
For Coal, Slate, Shale, &c.	52	7258	55	7566	52	7819	66	10,767	54	9119	47	7546	45	7185	35	6025
For Gold	647	6623	566	6091	425	4166	310	3117	243	2505	222	2268	195	2087	167	1836
Dredging Claims	—	—	—	—	—	—	—	—	15	124	29	469	51	1196	91	2027
Mining Easements	—	—	—	—	—	—	—	—	84	225	39	234	45	282	47	298
Water-rights Mineral and Gold	225	1004 sluice-heads	267	1318 sluice-heads	300	1691 sluice-heads	299	1514 sluice-heads	281	1460 sluice-heads	346	1495 sluice-heads	251	1477 sluice-heads	391	1606 sluice-heads

No. 15.

COMPARATIVE Statement of Revenue from Mines, being Rents, Fees, &c. (exclusive of Survey Fees), paid to the Treasury for the Years ending 30th June, from 1880 to 1903, and for Six months ending 31st December, 1903, and for the Years ending 31st December, 1904, 1905, and 1906.

Year.	Amount.			Year.	Amount.		
	£	s.	d.		£	s.	d.
1880	8944	5	11	1894	16,732	7	7
1881	20,936	5	5	1895	15,323	1	9
1882	23,077	1	9	1896	20,901	13	2
1883	15,439	14	5	1897	25,631	0	3
1884	6981	11	10	1898	33,061	13	9
1885	11,070	5	7	1899	24,096	10	5
1886	12,523	10	4	1900	28,380	11	10
1887	14,611	11	5	1901	21,569	5	2
1888	23,502	8	4	1902	19,471	0	1
1889	17,254	9	0	1903	17,776	14	3
1890	26,955	4	9	1903, 1 July to 31 Dec.	14,758	17	1
1891	37,829	16	5	1904, Jan. to Dec.	16,631	8	2
1892	17,568	18	4	1905	20,203	17	0
1893	16,971	9	2	1906	24,136	12	5

The above Statement does not include Stamp Duties upon Transfer of Leases and Registration of Companies, nor the Tax payable upon Dividends, from which sources large sums are derived.

No. 16.

RETURN showing the Total Number and Area of Leases in force on 31st December, 1906.

Minerals.	Number.	Area.
		Acres.
Gold	167	1836
Minerals	133	7622
Silver	154	8169
Copper	24	1252
Tin	970	24,811
Coal	23	3985
Limestone	4	383
Iron	11	528
Slate	1	200
Wolfram	8	394
Precious Stones	1	80
Lithographic Stone	1	97
Marble	1	317
Shale	4	1040
Phosphate of Lime	1	3
Nickel	6	180
Machinery Sites	27	98
Dredging Claims	91	2027
Mining Easements	47	298
Water Rights	391	1606 sluice-heads, and 1128 acres dams

No. 17.

RETURN showing the Average Number of Miners employed during the Year ending 31st December, 1906.

	Europeans.	Chinese.
Northern and Southern Division	886	1
North-Eastern Division	717	102
Eastern Division	615	66
North-Western Division	524	...
Western Division	4094	...
	6836	169

No. 18.

RETURN showing the Mining Companies registered during the Year ending 31st December, 1906.

Number of Companies.	Capital.
14	£178,090

In addition to the above, 24 Agents for Foreign Companies and 4 Syndicates, under 60 Vict. No. 51, were registered.

No. 19.

TOTAL Area of Land and Number of Sluiceheads of Water applied for during the Year ending 31st December, 1906.

Mineral.	No. of Applications.	No. of Sluiceheads.	Area.
			Acres.
Antimony	3	...	160
Coal	8	...	3245
Copper	55	...	3861
Galena	8	...	440
Gold	85	...	1076
Iron	1	...	80
Limestone	1	...	1
Minerals	141	...	8150
Silver	51	...	2994
Sulphide	1	...	77
Shale	19	...	2935
Tin	602	...	15,794
Wolfram	1	...	120
Machinery Sites	9	...	42
Dredging Claims	43	...	848
Water-rights	231	1050	171
TOTAL	1259	1050	39,994

No 20.

***RETURN** showing the total Amount of Rents, Fees, &c., received by the Mines Department during the Year ending 31st December, 1906.*

Head of Revenue.	Amount.
	£ s. d.
Rent of Auriferous and Mineral Land	21,505 14 3
Fees, ditto ditto	2630 18 2
Survey Fees	6023 9 5
TOTAL	£30,160 1 10

No. 21.

***RETURN** showing the Amounts paid in Dividends by Mining Companies during the Year ending 31st December, 1906.*

Mines.	Dividends.
	£ s. d.
Copper	360,000 0 0
Gold	...
Tin	208,846 0 0
Silver	67,563 0 0
TOTAL	£636,409 0 0

REPORT OF THE MOUNT CAMERON WATER-RACE BOARD FOR THE YEAR ENDING 31ST DECEMBER, 1906.

14th February, 1907.

SIR,

WE have the honour to present the report of the Board for the year ending 31st December, 1906.

Water.—The quantity of water sold during the year was 4147$\frac{7}{12}$ sluice-heads, which was sufficient to satisfy all requirements.

In response to the request of the Board, the Government, on the 25th of October last, passed a short Bill to amend The Mount Cameron Water-race Act, suspending the operation of Section 6, and enabling the Board to retain the whole of the moneys received during the period commencing the 1st day of July, 1905, and ending the 30th day of June, 1908, from the sale of water supplied by the race without making any payment thereout for the purposes of "The Public Debts Sinking Fund Act, 1881," and to use and apply the whole or any part of revenue so received and retained as it thinks fit in or towards maintaining, managing, repairing, or improving the water-race and the works connected therewith.

In addition to this, the Government provided a sum of £4000 on the Public Works Schedule for the purpose of renewals and repairs. If a similar amount is placed upon the estimates this year, and is available when No. 4 syphon is well in hand, the pipes could be delivered to the ground, and work commenced on No. 5 syphon immediately on completion of No. 4.

Flumings.—At the beginning of the year there were 23 flumings to be replaced by earth and rock-cuttings. Of these, 1, 2. 4. 8. 9, and 11 were completed, at a cost of £1612 10s. 6d., and should there be no serious break or other unforeseen accident cutting off the water-supply for any length of time, it may be reasonably expected that the revenue derived will be sufficient during the current year to cover the cost of replacing most of the remaining flumings.

Syphons.—There has been an increase in the number of breaks in the pipes, and these have been of a more serious nature than hitherto. There are 6 syphons in use. Of these, 4 and 5 require constant attention, bursts being of daily occurrence, which have necessitated repairs by means of iron bands to the extent of 269 on these syphons alone. Nos. 1, 2, and 3 syphons are shorter and of smaller dimensions, and it may be found possible by rock and earth deviations to dispense with Nos. 1 and 2.

The quantity of water supplied this year was 4147$\frac{7}{12}$ sluice-heads, as against 4325$\frac{1}{4}$ sluice-heads last year; and the quantity of tin ore raised was 94 tons 7 cwts. 1 qr. 23$\frac{1}{4}$ lbs., as against 75 tons 13 cwts. 15 lbs. last year, being

an increase of 18 tons 14 cwts. 1 qr. 8½ lbs. The revenue was £2835 17s. 11d., against £2581 0s. 10d. the previous year, being an increase of £254 17s. 1d.

The report of the Engineer-in-Charge on the work performed during the year is appended.

The statistics for the year are as follow :—

Average per week of claims supplied, 16.
Greatest number supplied in any one week, 21.
Total number of heads supplied :—

Under fixed or cash scale	3189 1/12
Under royalty or credit scale	958½
TOTAL	4147 7/12

Tin ore raised for the year :—Royalty scale, 15 tons 0 cwts. 3 qrs. 23½ lbs.; fixed scale, 79 tons 6 cwts. 2 qrs.; total, 94 tons 7 cwts. 1 qr. 23½ lbs.

Total receipts for the year :—Fixed scale, £2375 1s. 0d.; royalty scale, £460 16s. 11d.; total, £2835 17s. 11d.

Expenditure : Cost of maintenance and management :—

	£	s.	d.	£	s.	d.
Salary and wages...	593	14	0			
Repairs to syphon-pipes	128	7	4			
Repairs to flumings	18	16	0			
Race-cleaning	57	16	0			
Travelling expenses	35	19	0			
Stores and tools	16	7	4			
Stationery and printing	5	19	0			
Insurance	3	6	0			
				860	4	8
Renewal of flumings	...			1612	10	6
TOTAL	...			£2472	15	2

The payment to the Public Debts Sinking Fund of the profits made for the year ending 30th June, 1906, was suspended, under 6 Edward VII. No. 13.

Moiety of rents of mineral land served by the race paid to Public Debts Sinking Fund, £35 10s. 10d.

Total amount paid to Public Debts Sinking Fund to 30th June, 1906, £9869 5s. 5d.

Total cost of purchase and construction, £34,281 19s.

W. H. WALLACE, Chairman of the Board.

EDWARD L. HALL,
W. H. TWELVETREES,
S. HAWKES,
JOHN SIMPSON,
} Members of the Board.

The Hon. the Minister for Mines, Hobart.

ENGINEER'S REPORT.

Hynes' Camp, 3rd May, 1907.

SIR,

Report of alterations and repairs, Mount Cameron Water-race, for year ending 31st December, 1906 :—

I have to report that, acting under instructions from you, I resumed work in connection with alterations and repairs to the Mount Cameron Water-race on the 29th of March, and on the 31st I proceeded to Gladstone to obtain the necessary information to enable me to submit to you an estimate for work up to £1000, and to lay out such work, so that it might be let by tender if the Board so decided.

I returned to Launceston on the 12th May, and on the 13th June I submitted to you an estimate for work totalling £984 18s., *ex* supervision, with plans and details of cost.

The work dealt with was alterations to flumes Nos. 1, 2, 4, 8, 9. and 11.

On the 3rd July I again left Launceston, with your instructions to carry out these works, arriving in Gladstone the same day.

Owing to the very rough weather I was unable to move out till the 8th. The heavy weather delayed the arrival of the boat which was bringing tools, &c., from Launceston. Ogilvie's bridge, over the Ringarooma River, was washed away, and, in consequence, the things had to be carted by a road about 6 miles longer than the direct one. The Mussel Roe River, which has to be crossed by ford on the way to the intake of the race, was rendered impassable for some days by floods, and it was not till the 19th that I managed to get tools and start work.

The above works were completed on the 16th November, at a total cost for labour, plant, and material, of £933 7s. 5d. (*ex* supervision), and a statement of cost supplied to you.

Just before the completion of these works I was favoured by you with instructions to proceed with the more urgent of the other works, with a view to cutting out all the old flumes where possible.

Work was temporarily suspended on the 18th December, on account of the men unanimously wanting Christmas holidays, and up to that time the following additional work had been done :—

No. 12, complete, at a cost of, approximately, £112.
No. 3, almost finished, at a cost of, approximately, £105.
No. 7, in progress.

The total amount expended up to 31st December was £1652 5s. 2d., inclusive of plant, supervision, and all charges.

In all cases the old flumes have been replaced by permanent works, the creeks being picked up, thus adding to the available water-supply.

Yours obediently,

FRANK SNEYD GROVE,
Engineer in Charge of Works.

W. H. WALLACE, Esq.,
Chairman Mt. Cameron Water-race Board, Hobart.

MINE MANAGERS' EXAMINATION.

MARCH 20, 1906.

SUBJECT A.—MINING.

1. Discuss the relative methods of the following and explain under what circumstances you would use each—(*a*) Horse tram, (*b*) aerial tram (*c*) gravity tram (*d*) electric motor tram, (*e*) steam loco. tram.
2. You are prospecting for a deep lead. What surface indications would you consider? Describe the methods you would adopt and the precautions you would take.
3. Under what conditions would you expect to have to work in compressed air when tunneling? Describe, with sketches, an air-lock for the purpose.
4. Under what conditions would you use each of the following :—(*a*) Blasting powder, (*b*) gelignite, (*c*) blasting gelatine, (*d*) rack-a-rock. What are the qualities required in a good fuse? For driving a heading in a hard homogenous rock, show with sketches how you would place the holes, and state in what order you would fire them.
5. Describe, with sketches, any safety-cage.
6. Describe the ropes or chains you would use in the following cases, their construction and quality, the factor of safety you would adopt, the methods of testing, and the fastenings you would use :—(*a*) Haulage tram, (*b*) deep shaft, (*c*) blocks and tackle, (*d*) fib or travelling crane, (*e*) aerial tram, (*f*) guy for derrick in erecting machinery.
7. Explain how you would timber and maintain a drive in swelling ground.
8. Make a sketch of a head-gear 45 feet high for use with cages. Give explanation of details.
9. The outcrop of a lode has been traced 200 yards with trenches. How would you continue to prospect it with the sum of £1000 available?
10. Describe how you would work a vertical lode—30 feet to 40 feet wide—in good standing country—
    (*a*) When lode was picking ground.
    (*b*) When lode was solid quartz.
11. A shaft on a tin mine is to be sunk 1000 feet to contain a 12-inch Cornish pump. The trucks used in the mine carry three-quarters of a ton each, and are well designed. What size would you make the shaft, and how would you timber it? Give a sketch showing how you would place the pit-work.
12. Describe the way in which you would open up an alluvial lead about 200 feet below flat country.

SUBJECT B.—ORE-DRESSING AND SAMPLING.

1. How would you sample an irregular lode-tin formation, extending over a surface area of 15 or 20 acres, which has not been exploited to any extent by shafts or adits?

2. Describe the latest slime-concentrating appliance you are acquainted with—describe its action, and state under what conditions you would consider it suitable. Illustrate your answer with sketches.
3. Describe an automatic tailings sampler for use in connection with a battery, and explain how it is used.
4. Describe the different types of stone-breakers and their relative merits.
5. A 40-ton lot of rich ore is expected to arrive in railway trucks: explain how you would sample it.
6. What process of concentration would you use for silver-lead ore consisting of galena, carbonate of iron, and slate; the galena in part finely disseminated and part in masses? Describe the different machines you recommend.

SUBJECT C.—MINING GEOLOGY.

1. What are joints in rocks? Explain how they are produced.
2. Define the term "false bottom." Explain the origin of this phenomenon and how it affects the deposition of ore.
3. Describe possible natural conditions which may bring about the precipitation of metals in ore deposits.
4. Give some instances in which the presence of one metal in a lode may be looked upon as an indicator of another.
5. Describe how you would go to work to determine and represent the geological structure of a district.
6. Define the terms dip; hade; monocline; reversed fault; erosion.
7. Describe the characteristic features of replacement deposits.
8. Give an account of how you suppose gold quartz reefs to have originated.
9. Explain fully the essential differences between granite and serpentine; between conglomerate and slate.

SUBJECT D.—MINING SURVEYING.

1. A tramway between a main shaft and mill is about 12 chains long. Give a sample of a field-book showing reduced levels each chain.
2. Give a longitudinal section of the above tramline (Question 1) complete for construction purposes.
3. How would you lay out a curve on the above (Question 1) 5 chains long and 10 chains radius? Give all calculations.
4. Describe carefully the adjustments of the transit theodolite.
5. Describe fully a stadic method of contouring an approximately semi-circular quarry face of about 150 ft. rad. and 40 ft. high.
6. An incline shaft is sunk a vertical depth of 300 ft. on a lode underlying 45°, and levels have been driven at 100 ft., 200 ft., and 300 ft. from the surface. Winzes connect each pair of levels. How would you determine

the bearings of the drives without using a magnetic needle below the surface, and how would you check the bearings so obtained?

7. A quartz lode with an underlay E. 20° N. 70° carries a shoot of ore 200 ft. long pitching northerly. A vertical shaft cuts the southern end of the ore at a depth of 500 ft. Levels exist at 300 ft. and 700 ft. from the surface. Make a rough set of plans showing the above clearly.
8. In the above Question, make an estimate of the ore above the lowest level, assuming quartz in place to weigh 165 lbs. per cubic ft.

SUBJECT E.—SURFACE WORK.

1. A self-acting incline on a 1 in 20 grade is intended to lower 5 tons of mineral per trip in a truck weighing 2 tons. What sized rope would you use? Assuming a frictional resistance of $\frac{1}{10}$ of the total load, will the tram work?
2. Give sketches of a bridge 15 ft. high with 12-ft. spans, for a tramway on which the heaviest load is an 8-ton locomotive.
3. Give sketches of the arrangement you would adopt at a shaft for breaking 100 tons of quartz per day, and storing 300 tons.
4. What do you understand by the terms—

   Entry Head.
   Velocity Head.
   Friction Head.
   Total Head.

   Calculate the discharge of a 12-inch water-pipe, 100 ft. long, under a total head of 10 ft.
5. What is the safe working head of water for a 20-inch single-rivetted wrought-iron pipe $\frac{1}{8}$-in thick?
6. You wish to generate 250 horse-power by means of water. You have 150 horse-power available under a head of 300 ft., and 100 horse-power under a head of 180 ft.; you require to drive an electric generator direct by means of two Pelton wheels on an extension of the generator shaft: if the revolutions are to be 420 per minute, what diameters must the wheels have?
7. Outline the most economical scheme you can to transmit as much of the power mentioned in the previous question as possible over a distance of 10 miles, for the purpose of driving a stamper battery by means of one large motor, saying what losses you would expect in each part of the apparatus.
8. What size Cornish boiler would you require to give 100 indicated horse-power? Calculate the approximate weight for 100 lbs. pressure per square inch.
9. Two steel plates are lap-jointed, and rivetted together by one row of $\frac{1}{4}$-in. rivets pitched at $2\frac{3}{4}$ in. apart: what is the lowest percentage of the strength of the joint?
10. In a rope and pulley arrangement, having one quadruple and one treble sheaved block, what weight could you raise by applying a force of 150 lbs. on the fall of the rope? Neglect friction.

SUBJECT F.—BOOKKEEPING AND MINE ACCOUNTS.

1. When your company sends you stores for use at the mine, how do you arrive at the cost figures at which you enter them in your Stores Received Book?
2. Extract the square root of ·000525 to three decimal places.
3. Give some examples of pay-tickets issued to miners showing the net amounts due to them.
4. How do you reduce recurring decimals (pure and mixed) to vulgar fractions? Give examples.
5. Prepare a tabular statement showing an analysis of expenditure at a mine and battery, such as you would prepare periodically for the head office.
6. If 10 men earn £15 in eight days, what will 25 men earn in 40 days at the same rate?
7. Describe methods of forming an account for writing off depreciation on plant.

SUBJECT G.—MINING LAW.

1. What weight or strain is required to be used when testing new ropes or chains to be used in the shaft of a mine?
2. What is the maximum quantity of gunpowder or other explosives which may be stored in any mine, and what distance should same be stored from any travelling road?
3. What quantity of detonators is allowed to be kept in any one level in a mine, and how should same be stored?
4. Frozen nitro-glycerine compounds are required to be thawed or softened previous to use. How should this be done?
5. What constitutes a "sluice-head" of water under the Mining Regulations?

The following Lists of Certificates granted since the inception of the Board of Examiners for Mining Managers' Certificates are published in accordance with a resolution passed at the Interstate Conference of Boards of Examiners held in Melbourne in March, 1906 :—

SERVICE Certificates of Competency granted by the Board of Examiners.

No. of Certificate.	Name.	Date of Certificate.
1. 92	Davies, Joseph	28 Sep. 1892
2. 92	Buffon, Geo. Donald	28 Sep. 1892
3. 92	Sinclair, George Peace	28 Sep. 1892
4. 92	Heighway, John Felton	28 Sep. 1892
5. 92	Irvine, Peter	28 Sep. 1892
6. 93	Daniel, John	29 Mar. 1893
7. 93	Marshall, John Henry	29 Mar. 1893
8. 93	Aaron, Gabriel	29 Mar. 1893
9. 93	Webb, George	29 Mar. 1893
10. 94	Payne, John Greaves	3 Apr. 1894
11. 94	Wesley, William Henry	3 Apr. 1894
12. 94	Andrews, Thomas	3 Apr. 1894
13. 95	Richards, Moses John	17 Apr. 1895
14. 95	Richards, Stephen Eddy	5 Nov. 1896
15. 98	Stubs, Joseph Thomas	20 Jan. 1898
16. 98	McCrackan, John	20 Jan. 1898
17. 98	Heery, Luke	5 Mar. 1898
18. 98	Curtain, Cornelius Henry	13 Apr. 1898
19. 98	Clerk, Frederick Malcolm	14 Apr. 1898
20. 99	Craze, John	25 Jan. 1899
21. 99	Tilley, George Reynolds	17 Apr. 1899
22. 99	Hooper, Thomas Martin	17 Apr. 1899
23. 99	Vincent, Thomas	17 Apr. 1899
24. 1900	Brown, William	9 Jan. 1900
25. 1900	Rosewarne, David Davey	4 Oct. 1900
26. 1901	Buddon, William	1 Mar. 1901
27. 1901	Yeates, Alexander	29 Apr. 1901
28. 1902	Ireland, Mark	22 Apr. 1902
29. 1902	Woolcock, John	23 Sep. 1902
30. 1903	Powell, Robert William	5 May, 1903
31. 1904	Muir, John James	27 July, 1904
32. 1904	Moyle, John	5 Dec 1904
33. 1904	Ridley, John	12 Dec. 1904
34. 1906	Brough, Daniel	23 Apr. 1906
35. 1906	Berrill, Samuel	23 Apr. 1906
36. 1906	Barker, George	24 July, 1906

COLLIERY Certificates of Competency granted by Board of Examiners.

No. of Certificate.	Name.	Date of Certificate.	Class of Certificate.
1. 92	Brain, Austin Lionel Bennet	28 Sep. 1902	First class
2. 1907	Wallace, Archibald Campbell	23 Apr. 1907	Second class
3. 1907	Williams, Thomas James	8 May,1907	First class

CERTIFICATES of Competency granted by the Board of Examiners.

No. of Certificate.	Name.	Date of Certificate.	Class of Certificate.
1. 92	Dunstan, Alfred John	28 Sep. 1892	First class
2. 92	Ekborg, Benjamin Pherson	28 Sep. 1892	Second class
3. 92	Hill, Charles	28 Sep. 1892	Second class
4. 92	Booth, John Robert	28 Sep. 1892	Second class
5. 92	Stapleton, Michael	28 Sep. 1892	Second class
6. 92	Lewis, Philip	28 Sep. 1892	Second class
7. 92	Hanlon, Christopher	28 Sep. 1892	Second class
8. 92	Williams, Luke	28 Sep. 1892	Second class
9. 92	Macandrew, Harold	28 Sep. 1892	First class
10. 92	Harris, William	28 Sep. 1892	First class
11. 93	Stapleton, Michael	29 Mar. 1893	First class
12. 93	Hanlon, Christopher	29 Mar. 1893	First class
13. 93	Potter, Joseph Matthew	29 Mar. 1893	First class
14. 93	Hilder, Alfred	29 Mar. 1893	Second class
15. 93	Matthews, Peter	29 Mar. 1893	Second class
16. 93	Richards, Stephen	6 Sep. 1893	First class
17. 94	Brain, Austin Lionel Bennet	3 Apr. 1894	First class
18. 94	Thorpe, Walter	3 Apr. 1894	Second class
19 95	Williams, Luke	17 Apr. 1895	First class
20. 96	Levings, Joseph Henry	6 May,1896	First class
21. 99	Goodall, Thomas Charles	14 Apr. 1899	Second class
22. 1900	Schloesser, Robert	19 May,1900	First class
23. 1900	Nicholls, Charles Berresford	19 May,1900	First class
24. 1900	Sale, William Robert	19 May,1900	Second class
25. 1900	Williams, Richard	19 May,1900	Second class
26 1900	John McPeake	1 Aug. 1900	First class
27. 1901	Sawyer, Basil	20 Feb. 1901	First class

CERTIFICATES of Competency—continued.

No. of Certificate.	Name.	Date of Certificate.	Class of Certificate.
28. 1902	Provis, John	22 Apr. 1902	First class
29. 1902	Bird, Robert Chisholm	22 Apr. 1902	Second class
30. 1902	Briggs, William Albert John	22 Apr. 1902	Second class
31. 1902	Bartlett, William Henry	22 Apr. 1902	Second class
32. 1902	Phœnix, William	22 Apr. 1902	Second class
33. 1902	Wright, Herbert E.	22 Apr. 1902	Second class
34. 1902	Craze, John	30 Apr. 1902	Second class
35. 1903	Waller, Richard Fitzarthur	5 May,1903	First class
36. 1903	Brickhill, Hector Gordon	5 May,1903	First class
37. 1903	Barker, Reginald Fredk.	5 May,1903	First class
38. 1903	Vincent, Thomas Henry	5 May,1903	First class
39. 1903	Crittendon, James Henry	5 May,1903	First class
40. 1903	Weston, Eustace Moriarty	12 Aug. 1903	First class
41. 1903	Clark, Lindesay Colin	31 Aug. 1903	First class
42. 1904	Martin, Edward Patrick	17 Feb. 1904	First class
43. 1904	Herman, Hyman	29 Apr. 1904	First class
44. 1904	Murray, Russell Mervyn	29 Apr. 1904	First class
45. 1904	More, George Allan	14 Oct. 1904	First class
46. 1905	Beamish, William Abraham	3 Jan. 1905	First class
47. 1905	Andrews, Thomas J.	1 May,1905	Second class
48. 1905	Hitchcock, William E.	1 May,1905	First class
49. 1905	Smith, George Oliver	18 July,1905	First class
50. 1906	Rockett, Hildreth Peyton	23 Apr. 1906	Second class
51. 1906	Hales, Richard Chilman	23 Apr. 1906	Second class
52. 1906	Debenham Arthur John	28 June,1906	First class
53. 1906	Coote, Charles Edward	18 Oct. 1906	First class
54. 1907	Marks, Oscar Sidney	8 Mar. 1907	First class
55. 1907	Phelan, Bernard Fredk.	23 Apr. 1907	Second class
56. 1907	Moline, Arthur Howard Pritchard	23 Apr. 1907	First class
57. 1907	Macartney, Ross Kenneth	23 Apr. 1907	First class
58. 1907	Williams, Thomas James	8 May,1907	First class

REPORT OF THE GOVERNMENT GEOLOGIST.

Government Geologist's Office,
Launceston, 31st December, 1906.

SIR,

I HAVE the honour to present my Report as Government Geologist for the year ending 31st December instant.

During the year I have prepared the following geological reports:—

1. On Mathinna Goldfield, Part I., 29th March, 1906.
2. On Mathinna Goldfield, Part II., 27th August, 1906.
3. On Cox's Bight Tinfield, 5th December, 1906.
4. On Renison Bell Tinfield, 18th December, 1906.

Mathinna Field.

This important field, containing the deepest gold mines in the State, was visited three times, and its structure very carefully examined. The large reef at the New Golden Gate, the premier mine of the district, although continuing as a powerful body of quartz to below the 1600-feet level, has gradually fallen off in value, and the geological investigation of the reef features therefore assumed a considerable degree of importance. The conclusions arrived at were that capital may be expended advantageously in exploring at the 1600-feet level, and in resuming the sinking of the main shaft, to prove the reef at a still greater depth. This is now being done.

The important adjoining deep mine, the Tasmanian Consols, was also examined, and abundant reasons disclosed for further sinking and vigorous reef exploration and development of the mine. Shaft-sinking here is now also down to 1600 feet.

There are several partially developed mines at Mathinna, at which work has been abandoned for one reason or another, but which are nevertheless fair exploring propositions. If the New Golden Gate and Tasmanian Consols owners meet with success in their present exploratory policy, there is no doubt that the whole field will receive a powerful stimulus, and work be resumed at many of the mines now idle.

There is no sound reason for pessimism with regard to the district, for the quartz reef formations at the several mines are not mere haphazard, exceptional occurrences, but are the result of a great physical process, the evidences of which may be seen continuously all along a line from Mangana to Mt. Victoria, and apparently still further north.

This great gold quartz line is a permanent structural feature of the island, and its conservation for mining purposes should be jealously watched and secured, for within its limits mining for the precious metal may be expected to persist for a quite indefinite period.

Cox's Bight Tinfield.

I visited this little-known field in September. It is on the shore of a broad bay on the South Coast of Tasmania, about 12 miles from South-West Cape.

Alluvial tin-mining is proceeding on the property of the Cox's Bight Tin Mines, N.L., where there are terraces of wash yielding between 1 and 2 tons of tin ore per cubic yard. The tin is derived from quartz and greisen veins intersecting granite hills, which form the southern termination of the Bathurst Range.

Below the terraces are extensive alluvial flats, which have not been bottomed. The Kent Tin P.A. have a large area of lagoon flats, which it is intended to prove by bore-holes before placing any machinery on the property. This comparatively small granite area is surrounded by ancient quartzites and schists, which are in places intersected by mineral veins. They belong to the Port Davey series of rocks, in which district copper and antimony ores are known to occur. When this remote part of the country is better known and opened up, it is probable that discoveries of importance will be made. Means of overland communication are urgently required.

Renison Bell Tinfield.

I paid a visit to this field in December. Tin ore is found in the North-East Dundas district over an area of 3 miles long by about a mile or so in width. The sedimentary rocks have been penetrated first by basic eruptions and then by intrusions and dykes of granitic origin, the tin ore being casually connected with the latter. The detrital ore is tin oxide, and the lodes are either quartz-cassiterite or pyritic. Many large nuggets of ore have been found, weighing several pounds, and occasionally even huge boulders. One of these boulders from the Gormanston property, weighing 19 cwts., and assaying 58·7 per cent. metallic tin, is on view in the Tasmanian Museum, Hobart. It is estimated that the district has produced between 200 and 300 tons of tin ore, and mining at the present time is exceedingly active there. The Renison Bell property possesses some large pyritic lodes, and detrital tin ore deposits of considerable value. A scheme of developing and working these is being devised by the owners. Neighbouring properties are being worked, and others prospected, with the result generally of showing that the tin-bearing formations are more numerous and better than hitherto supposed.

Visit to Lisle Goldfield.

I paid a departmental visit to this field in June, in connection with applications for purchase of land within the Mineral Reserve. This was at one time the most productive alluvial field in Tasmania, and has yielded at least 80,000 ozs. of gold. At present only 20 to 25 ozs. per month are being won.

It has always been a puzzle where the great accumulations of gold came from, as the usual gold quartz reefs are absent. Very few stones of gold-bearing quartz have been found, and where quartz has been adherent to anything, sandstone has been the matrix. Soft granite bed-rock underlies the basin and rises up the slopes of the surrounding hills, and occasion-

ally small veins ¼ to 1 inch or 2 inches in thickness of quartz, kaolin, and gold-bearing manganiferous iron oxide are met with in it. Such veins may have contributed to the general output, but a good deal of the gold originating in the field itself possibly came from the contact of the granite with the sandstone higher up the sides of the valley. The gold is usually fine, and the wash clayey. The stones are not much water-worn, and consist chiefly of sandstone from the surrounding hills, chalcedonised quartz, which has been released from the granite, and pieces of reef quartz. Quartz wash is not very abundant; clay and sandstone gravel appears in most of the terraces. A narrow gorge in slate forms the present outlet to the Lisle basin, but this outlet must be of modern date, formed subsequently to the deposit of the gold-bearing clays, some of which are below the level of the rocky bar at the entrance to the gorge. The width of the belt which has been worked is about 200 yards, so that the features are more those of a lake than of a gutter. At the same time certain runs are better for gold than others. The granite floor is perhaps a couple of miles wide. Terraces of alluvial occur at different heights up the surrounding hills, on the west as high as 300 feet and upwards, and the existence of a saddle on the hill crest on the west side opposite the township has suggested a local theory of the outlet having formerly been in that direction. The largest nugget found is said to have weighed 15 dwts. Other pieces have weighed from 1 to 2 dwts. The field deserves study and examination, with a view of locating the source of the gold, if possible.

Progress Reports.

Four of these have been prepared during the year. They show the output of mineral from the different mines in each district each quarter, and the value of the same, as well as the number of men employed. The obligation to furnish these statistics within fifteen days after the end of each quarter is imposed on mine owners and mining managers by "The Mining Act, 1905." It necessarily takes some time to collect them from remote parts of the State, and further time to compile the reports, but these have been prepared, as a rule, with tolerable regularity. However, sometimes their publication has been late, owing to subsequent delay in another quarter.

Mining information is earnestly solicited from legal or mining managers, prospectors, and all who are interested in disseminating knowledge of the mineral resources of the State. These reports are much sought after abroad, and are mailed regularly to institutes, mining engineers, and investors in different parts of the world, and from statistical publications which reach this office from time to time, it is evident that our reports are of use. Any definite suggestions for their improvement will be welcomed, and carefully considered.

Office.

In addition to the four geological reports and four progress reports issued during the year, correspondence consisting of 2493 letters, packets, &c., in and out, have been attended to.

A small collection of rocks was received from the Imperial Museum, Vienna, and individual specimens have been received

from Messrs. G. R. Bell, W. R. Bell, W. F. Petterd, Aug. Simson, and Dr. Thompson.

Numerous examinations have been made of gems and supposed gems, which have probably been submitted in consequence of the discovery of a diamond in Harvey's Creek, Donaldson Range. This small diamond, ¼ of a carat, was found in washing for gold in the creek, but though others were found in the same district as far back as 1894, prospecting has not revealed any more.

Mr. F. S. Grove has been acting as engineer to the Mt. Cameron Water-race Board since 31st March, and consequently has been absent from the office from that time. To meet the requirements of the office, Miss R. E. Higgs was appointed shorthand writer and typiste on the 26th March, under the temporary employment section of the Public Service Act, and has discharged her duties satisfactorily.

Government Drills.

The diamond drills were not used this year. The alluvial boring plant was hired out on 27th March to Mr. H. Mackay, for testing ground in the Stanley River district.

Assays and Analyses.

The retrenched lines on which the Government Analyst's branch is being carried on has caused useful work to remain in abeyance. Under the circumstances, very few samples have been forwarded for assay. Inconvenience is caused thereby in several ways. In the first place, I am precluded from taking as many samples as I could wish of lodes and lode-formations on my visits to mineral fields. Then many specimens are brought to me by prospectors and others, concerning which useful information cannot be given without analytical tests. Again, no research work is possible under present conditions. Some of our ores and rocks require complete analysis, in order to determine what they really are.

The want of a standard analyses makes it impossible to publish definite statements and determinations, and places the geological branch at a disadvantage compared with other countries. For these reasons I should be glad to see the Government Laboratory made available for the work with which I could supply it almost continuously.

Geological Survey.

I touched upon this subject in a former report, and the reasons for initiating this which existed then hold good with increased force now that our industry is justifying the predictions which have been continuously made by the officers in charge of the geological branch of your Department. To initiate a survey on a modest scale would mean an expenditure of from £1000 to £1500 annually; but for that outlay, what was done would be well done. A surveyor and two men (with geological supervision and camp expenses) continually at work for the greater part of the year would cost about £30 weekly, and would survey a square mile or two per week in our usual bush country. This would be equivalent to £20 to £30 per square mile.

There are many mining fields on the West Coast which are in urgent need of such a survey, and which would very soon reimburse the State for the outlay. As instances, I would mention the West Coast Range, from Mt. Darwin to Mt. Farrell, the Dundas field, the Meredith Range, Mt. Balfour, and there are others.

An improved geological sketch map of the State is now almost a necessity, and it is highly desirable to adopt measures to collect information, and supplement that already in hand.

Bulletins.

For some time past I have recognised the desirability of issuing publications of this description, giving all the information available concerning the occurrences of the respective economic minerals of the State in a concise and useful form. A series of such bulletins, covering in turn the occurrences of iron, gold, copper, lead, tin, wolfram, asbestos, &c., would, I am convinced, be of considerable use to the prospector and investor, as well as to the Department itself. Want of assistance has prevented me from carrying out my intentions in this respect, but as soon as this drawback is removed I purpose making a start.

I have the honour to be,
Sir,
Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

W. H. WALLACE, Esq., Secretary for Mines, Hobart.

REPORT OF THE CHIEF INSPECTOR OF MINES.

Chief Inspector of Mines' Office,
Launceston, 31st December, 1906.

SIR,

I HAVE the honour to submit my Report on the inspection of mines during the year ending 31st December instant.

The appended statistical tables and diagram furnish information respecting the number and nature of accidents which have occurred at the mines and works attached thereto during the twelve months.

I beg to supply annual reports by the Inspectors of Mines, viz.:—Mr. M. J. Griffin, for the Northern and Southern, Eastern, and North-Eastern Divisions; Mr. James Harrison, Inspector of the Western and North-Western Divisions; and Mr. C. H. Curtain, Inspector for the Lyell District.

The number of persons employed this year in and about the mines and smelting works was 7004. The cases of fatal injuries were 4; and non-fatal serious injuries were 61. The death rate from accident was 0·57 per thousand, compared with 1·06 per thousand in 1905.

This ratio is the lowest that has yet been recorded in Tasmania. The appended diagram shows strikingly the improvement which has been attained in this respect in recent years, the death ratio per thousand prior to 1899 being for the most part higher than 1·5, and since that time always lower than that figure. On the other hand, the non-fatal accidents registered have been more numerous than usual, partly perhaps in consequence of increasing strictness in recording them, and partly, in all probability, owing to the increased pressure and magnitude of work at some of our larger mines. Thus, 15 out of the 17 accidents recorded in the Northern and Southern Division occurred at one mine; and on the West Coast one company figures for 18 casualties out of 33 occurring in the Western Division.

The individual reports on accidents which have been furnished by the Inspectors show that careful investigation has been made in each case, and they have been subjected to serious consideration by myself. I may mention that I am devoting increasing time and attention to the numerous matters constantly arising in connection with the regulation of mines. The work of the Inspectors has been materially increased, in consequence of the new Mining Act. It has taken some time and trouble to impress mine owners and managers with the urgency of the new working rules and provisions. In some instances there has been an unwillingness to appreciate them, and the Inspectors have had to overcome a silent and persistent opposition as tactfully as possible. I wish here to mention the satisfactory manner in which all the Inspectors have discharged their duties.

The Inspectors are giving special attention to the subject of underground ventilation, which so intimately affects the

health of the miners, and their reports deal with the matter in detail. On the whole, the ventilation and sanitation of our mines are fairly good; one or two exceptions as regards ventilation are engaging attention, and a remedy is being sought.

In one or two respects the necessity has been disclosed for amendations of the Act. One of these is that all lessees should be subject to Part VIII., which is the part of the Act dealing with the working and regulation of mines. The administration of varying rules and regulations under different Acts in one and the same district is excessively difficult, and imposes needless tasks on the Inspectors. Another is in connection with the duty placed on the mining manager of reporting the return to work of persons sustaining accidents which seem to be merely trivial. What is required is simply that their non-return within a stipulated time (fourteen days) be notified to the Inspector. It is only to be expected that in the working of such a comprehensive Act modifications of the working rules will suggest themselves from time to time.

With a view of checking gold-stealing, by making it more difficult to dispose of stolen gold, I venture to suggest for your consideration the initiation of legislation making it unlawful to sell or consign gold otherwise than through bankers, such bankers to furnish periodical returns of purchases or consignments of gold.

I have the honour to be,
Sir,
Your obedient Servant,

W. H. TWELVETREES,
Chief Inspector of Mines.

W. H. WALLACE, Esq., Secretary for Mines, Hobart.

Diagram showing the ratio of fatal accidents in mines in Tasmania.

Rate per 1000 men employed.

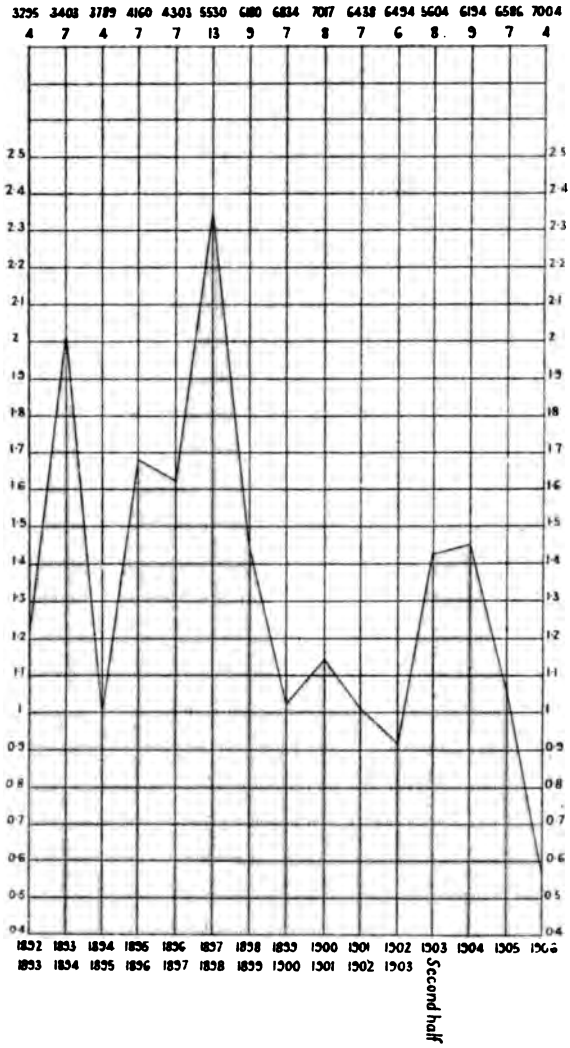


Photo-algraphed by John Vail Government Printer Hobart Tasmania

TABLE showing Rate per Thousand Killed and Injured in the different Divisions for the Year 1906.

Period.	Division.	Average number of men employed.	Number of Accidents.	Number of Persons.		Total number Killed & Injured.	Average per 1000 Killed and Injured.	Average per 1000.	
				Killed.	Injured.			Killed.	Injured.
1 Jan. to 31 Dec., 1906	Northern and Southern ...	887	17	1	16	17	19·165	1·127	18·038
Ditto	North-Western...	524	1	Nil.	1	1	1·908	Nil.	1·908
Ditto	North-Eastern	818	5	1	4	5	6·113	1·222	4·889
Ditto	Eastern	681	9	1	8	9	13·215	1·468	11·747
Ditto	Western	4094	33	1	32	33	8·060	0·244	7·816
		7004	65	4	61	65	9·20	0·57	8·70

Analysis of Statistics for the Western Division.

Division.	Average number of men employed.	Number of Accidents.	Number of Persons.		Total Killed & Injured.	Average per 1000 Killed and Injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
Mount Lyell	2424	24	—	24	24	9·90	—	9·90
Zeehan, &c.	1670	9	1	8	9	5·38	0·59	4·79
Total	4094	33	1	32	33	8·06	0·24	7·81

TABLE showing the Number of Persons Killed and Injured in and about the Mines of Tasmania during the Year 1906.

Place or Cause of Accident.	Inspection Districts.													
	Northern and Southern Division.		North-Eastern Division.		Eastern Division.		North-Western Division.		Western Division.				Total.	
									Zeehan and other Districts.		Lyell District.			
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Underground—														
Falls of Ground	...	3	...	...	...	1	...	...	...	2	...	2	...	8
Shaft Accidents—														
Machinery	1	...	...	...	...	...	...	...	...	1	...	...	1	1
Things falling down shafts	...	2	...	...	...	1	...	...	...	...	...	...	...	3
Buckets	...	1	...	...	...	...	...	...	...	...	...	...	...	1
Lowering material	...	1	...	...	...	...	...	...	...	...	...	...	...	1
Falling down passes	...	...	...	...	...	...	...	...	...	...	...	3	...	3
Total	1	4	...	...	...	1	...	...	...	1	...	3	1	9

Miscellaneous (underground)	...	...	...	...	...	...	...	...	...	...	...	2	...	2
Haulage—														
Trams, &c.	...	3	...	...	...	...	...	...	...	...	...	1	...	4
Explosives	...	...	...	...	...	1	...	...	...	...	...	...	...	1
Total	...	3	...	...	...	1	...	...	...	...	...	3	...	7
Total underground	1	10	...	...	...	3	...	...	...	3	...	8	1	24
ON SURFACE—														
Smelting Works	...	...	...	...	...	...	...	...	...	3	...	11	...	14
Machinery	...	2	...	...	...	...	...	...	...	1	..	...	...	3
Falls of ground	...	1	..	2	...	...	...	...	1	1	...	1	1	5
Falls of stone	...	...	...	...	...	1	...	...	...	...	...	...	..	1
Tramways	...	1	...	...	1	1	...	1	...	...	...	1	1	4
Explosives	...	...	...	...	.	1	...	...	...	...	...	1	...	2
Dredges	...	...	1	...	...	...	...	...	...	...	...	...	1	...
Fall of Trestles	...	...	...	1	...	2	...	...	...	...	...	...	...	3
Chemical works	...	1	...	...	...	...	...	...	...	...	...	...	...	1
Miscellaneous	...	1	...	1	...	...	...	...	...	...	...	2	...	4
Total surface	...	6	1	4	1	5	...	1	1	5	...	16	3	37
GROSS TOTAL	1	16	...	4	1	8	...	1	1	8	...	24	4	61
Total during 1905	3	13	...	3	...	3	...	...	1	5	3	6	7	30

COMPARATIVE Table of Statistics of Accidents in and about the Mines of Tasmania from 1st July, 1892, to 31st December, 1906.

Period.	Number of Miners employed.	Number of Accidents.	Number of Persons.		Total killed and injured.	Average per 1000 killed and injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
1 July, 1892, to 30 June, 1893	3295	28	4	25	29	8·8001	1·214	7·586
„ 1893 „ 1894	3403	25	7	20	27	7·934	2·057	5·877
„ 1894 „ 1895	3789	26	4	24	28	7·390	1·058	6·332
„ 1895 „ 1896	4160	22	7	16	23	5·529	1·682	3·847
„ 1896 „ 1897	4303	36	7	31	38	8·831	1·627	7·204
„ 1897 „ 1898	5530	36	13	33	46	8·318	2·351	5·967
„ 1898 „ 1899	6180	35	9	34	43	6·957	1·456	5·501
„ 1899 „ 1900	6834	19	7	16	23	3·365	1·024	2·341
„ 1900 „ 1901	7017	29	8	23	31	4·417	1·140	3·278
„ 1901 „ 1902	6438	38	7	35	42	6·524	1·088	5·437
„ 1902 „ 1903	6484	44	6	43	49	7·557	0·925	6·632
„ 1903, to 31 Dec., 1903	5604	27	8	20	28	4·977	1·428	3·569
1 Jan., 1904 „ 1904	6192	73	9	65	74	11·951	1·454	10·497
„ 1905 „ 1905	6586	34	7	30	37	5·618	1·063	4·555
„ 1906 „ 1906	7004	65	4	61	65	9·280	0·571	8·709

REPORTS OF INSPECTORS OF MINES.

MR. INSPECTOR GRIFFIN (stationed at Launceston) reports :—

I have the honour to submit my annual report on mines inspected in the Northern and Southern, North-Eastern, and Eastern Divisions during the year ending 31st December, 1906.

Accidents.—Three fatal, and 28 non-fatal accidents have been reported and recorded during the year. Of the non-fatal accidents, some 15 or 16 were of a serious nature, such as broken limbs, severe cuts on head, bruises and contusions on body; also burns from explosions in 2 cases. The remaining 12 accidents could be considered serious only by their coming within the definition of "Serious"—enforced absence from work for fourteen days—as set forth under Section 181 of the Act. As a matter of fact, this fourteen days' absence from work does not always indicate that such absence is altogether caused through the injuries received. Men very often take advantage of their apparently enforced absence through accident, and go about other business, or take a holiday, knowing that their place on the mine will be kept open for them. It is impossible for the managers to keep the run of every man who leaves after, perhaps, some trivial accident, and say whether the absence of fourteen days is due to the injuries received or not. He has, nevertheless, to report the accident as serious if the man does not return before fourteen days have elapsed. Cases are known where the doctor has pronounced the injured person fit to return to work, yet he had not returned to his place on the mine for several days afterwards.

Fatal Accidents.—William Anderson, a young man, single, was employed at the Ringarooma Company's bucket-dredging plant, and was filling barrows and otherwise assisting to get gravel ballast aboard the barge, when, on walking forward on the barrow-plank to trim down the heap of gravel on the barge, and having thrust his shovel into the heap, he lost his balance, and fell into the water, immediately disappearing beneath the sloping end of the barge. Some thirty minutes elapsed before the body could be recovered; life, of course, was extinct. No person was to blame for this unfortunate occurrence, which was purely accidental. It was after nightfall, but the place was well lighted by electricity.

William Cairns, a young married man, was employed at the 400-feet in the capstan division of Hart's shaft, at the Tasmania Gold Mine, landing and tipping trucks of material for making concrete, which was being hoisted from the 900-feet level. The catches in some way got damaged, probably through not being fully open to allow the ascending cage to pass through. Cairns, instead of reporting the matter to the proper authority, and getting the necessary repairs effected by the men whose duty it was to attend to such things, set about the work himself, first having signalled the cage up some 8 feet above the flat, where it was suspended for the time being. He succeeding in getting some of the bolts out

of the catch-gearing, and whilst stooping to get at the other parts was struck by the descending cage, sustaining a very severe wound on the chin, also fracture or breaking-out of portion of the lower jaw-bone, with 4 teeth. He was attended by Dr. Johnson, who removed the fragment of broken jaw and teeth, and ordered Cairns' removal to the Launceston Hospital, where he was received on the following day, and where he died five days later. The body was taken back to Beaconsfield, and a *post-mortem* made by Dr. Gmelin, who gave a certificate attributing the cause of death to septic pneumonia. The coroner's inquest in this case lasted seven days, a lot of evidence being taken, principally in connection with the Beaconsfield doctor's treatment of Cairns immediately after the accident occurred. The jury gave a verdict, "That William James Cairns met his death at the Launceston General Hospital on the 9th day of June, 1906, from suffocation and septic pneumonia, resulting from an accident received at the Tasmania Gold Mine, Beaconsfield, on the 4th day of June, 1906," but could not agree as to the cause of the accident, or whether any person was to blame for it. Subsequently, action was taken against the Tasmania Company by the widow of the deceased to recover damages for the loss of her husband, through alleged carelessness on the part of the Company's enginedriver, who, it was said, lowered the cage without having received a signal to do so, or allowed the cage to creep, it being held by steam without the application of the brake. The jury gave a verdict awarding Mrs. Cairns £500 damages, they being of opinion that the cage was allowed to creep. Against this decision the company has now appealed to the Full Court, on the grounds that the verdict is opposed to the evidence of several expert witnesses, who gave it as their opinion that it was quite safe to hold the cage with steam, and that no creep took place. In this latter opinion I entirely concur. The enginedriver may possibly have lowered the cage without getting a signal, but from tests made, and from the construction of this capstan engine, with its multiple gearing and regular steam supply, I am satisfied that no creep took place. Cairns alone was, in my opinion, to blame for the accident that caused his death.

William Nichols, aged 58, married, was employed at the Cornwall Colliery, at surface-work. He placed a packing-box used for galvanised iron on the top of two skips loaded with coal, for the purpose of getting it down to the bottom of the self-acting incline tramway. Having lashed the box with a rope tied down to the drawbar between the skips, he got on to the hindmost skip of the set, standing with one foot on the buffer and the other on the drawbar. When the set of loaded skips had almost approached the passing-place, about half-way down the line, the brakesman, Wm. Bullock, from his position at the top of the incline, noticed that Nichols was handling the end of the box, which appeared to be slipping to the side on which the set of empty skips would pass, and fearing a collision he suddenly applied the brake and stopped the set. Nichols was thrown off, and was found a few minutes afterwards on the side of the line about 10 feet back from the skip on which he was riding. He was sensible when picked up, but it was evident that he had received severe injuries

about the region of the liver and pit of the stomach. He was removed to the Launceston Hospital, where he died two and a half hours after being admitted, or twenty-five and a half hours after the accident occurred. At the inquest the jury returned a verdict, "That deceased met his death accidentally on the self-acting tram at the Cornwall Company's Mine, whilst riding on a skip, through the sudden application of the brake by the brakesman, while trying to avert an accident." I quite concur with this decision as to the cause of the accident. The sudden application of the brake would have the effect of jerking the rope and lifting the last skip off the rails, and at the same time breaking the box across the middle where the rope lashing passed over it. Half of this box was found on the ground near where Nicholls was lying; the other half was still on top of the second coal skip. There was no printed or written regulation on the mine prohibiting persons from riding on the skips loaded or empty; nevertheless it was known and understood by the brakesmen and employees generally that they would not be allowed to ride on the self-acting incline. Some blame is attachable to the brakesman, Wm. Bullock, for having allowed Nichols to ride on the skips, but having done so, he could not be blamed for suddenly applying the brake to avert what he believed to be an impending collision with the box on the loaded skips and the empty skips coming up on the other side. The deceased was, on a previous occasion, warned by the brakesman that he must not ride on the skips, but being an old hand at the colliery, and a man of a rather obstinate disposition, he did not heed the warning.

Serious Accidents.—Ernest Page, age 23, single, was working a knocker line at the bottom of Grubb's shaft (Tasmania Mine), when he was struck in the eye. Subsequently he went to the Launceston Hospital, where the doctors found it necessary to remove the injured eye. Three months later he returned to work at the mine.

Oscar Radcliffe, age 25, single, was employed in the sluicing-face of the Mutual Hill Tin Mine. A fall of earth took place, and he was caught by a large boulder, which rolled over him. He sustained severe bruises about the hip and ankle, which caused him to become an inmate of the Launceston General Hospital for several weeks.

Thomas Hall, age 23, single, was employed driving a heading in the Sandfly Colliery. There was some slight faulting of the seam, which caused a "canch" of stone to rise in the floor. Short props were used on one side, and proper care was not taken to secure the ground when these were being replaced by the full-length timber. Hall and his mate had just commenced work, when they noticed signs of insecurity in two sets. They had scarcely set about remedying this, when a heavy fall of the stone roof occurred. Hall was caught, and had his leg broken below the knee; also received a severe cut in the groin. His mate, Alf. Doran, escaped uninjured. Hall was conveyed to the Hobart Hospital. There was some lack of proper inspection of the place before the men went to work; this, coupled with their inexperience of dangerous ground caused the accident to Hall, which might easily have been avoided had he known how to set about his work properly.

Horace Spargo, age 15, was running a truck at the 1000-feet level, Tasmania Mine, when his foot was caught in tram rail, and the small bone of his left leg was fractured above the ankle. He was off work for seven weeks.

R. Kelly, age 50 years, married, employed at the Anchor Tin Mine, was riding on a truck hauled by a horse. The gearing became detached and the truck ran back. Kelly jumped off, and sustained a broken collar-bone.

James Dunstan, age 50, married, was assisting to lift a long cap into position in one of the stopes in the Tasmania Gold Mine; a large fall of quartz suddenly took place close at hand. All the other men escaped, but Dunstan was caught by rolling lumps of quartz, and had both his legs broken. He recovered from the effects of these injuries, but having caught a cold whilst lying in the Beaconsfield Hospital, died from pneumonia.

James H. Waters, age 62, married, was, with his mate, ascending on the bucket used at Lefroy shaft, Tasmania Gold Mine, when the swaying of the bucket brought his head in contact with a projecting stage-board. He sustained two severe cuts on the head, and it was seven weeks before he returned to work. The stage-boards referred to were at a place of refuge, to where the men were hoisted during blasting operations. They could easily have kept the bucket from swaying to the side had they taken ordinary precautions.

James Herrick, age 41, married, was charging a drill-hole at the foot of the open-cut face at the Anchor Tin Mine. A falling stone struck him on the head, inflicting a wound that caused him to be off work for four weeks.

Wm. Geo. Hodges, age 41, married, was assisting the sluicer on an elevated tail-race at the Transit Tin Mine, when a general collapse of the trestle-work and boxes took place. He sustained a severe shock and injuries to the back, which incapacitated him from work for over six weeks, the greater part of which time he was in the Launceston Hospital.

John Breen, single, was engaged as sluice-man at the Weldbrook Tin Mine. The trestling supporting the boxes gave way, and he fell with the boxes and sustained injuries to his back which kept him from work for some considerable time.

William Lucas, single, was charging and firing some blasting-holes at the Fancy Creek Tin Syndicate Mine. In spitting the fuse at one hole he carelessly ignited some loose grains of powder, which, in turn, caused the explosion of some 5 or 6 lbs. of powder in a keg close by. He received some severe burns on his hand and arm, and was off work for three weeks.

Joseph Hunkin, married, had a small bone of his left arm broken, caused by a stone falling down a pass he was emptying at the Tasmania Gold Mine. He was off work about five weeks.

Thomas Gordon Peden, married, was engaged shaft-sinking at the Tasmanian Consols Mine. He and his mate, Wm. Blair, had fired some pops to make room for an opening set at the 1600-feet flat. They descended before the smoke had cleared away, and were standing on the frame-set when a large piece of rock fell from the side-wall about 8 feet up, and

brushing Peden knocked him into the well. He sustained a fracture of the leg-bone above the ankle. These men could not have properly tested the ground as they descended after firing, otherwise the faulty nature of the side-wall would have been noticed.

M. J. Breen, single, was engaged excavating in the open-cut at the Burnie Copper Mine. He eased a large boulder with his pick, which rolled on to his leg, breaking the small bone above the ankle. He was off work for four weeks.

J. Williams, married, stoping in the Tasmania Gold Mine, was easing a large lump of quartz, which came away, breaking a cap piece, and he fell about 7 feet, sustaining a nasty cut on his head and bruises on his leg. He had not returned to work at expiration of fourteen days from the date of the accident.

Robert Croft, jun., age 24, single, was charging a hole in a cross-cut at the Mangana (Tas.) Gold Reefs Mine, using a heavy copper tamping bar. He must have applied some force when pressing the first plug of gelignite home in a 20-inch hole, as it exploded. Croft received some rather severe burns on his right arm and a slight peppering of grit. Fortunately, the drill-hole was obliquely to the line of face, otherwise the consequences might have been serious to Croft, and to his mate, who was standing behind him.

The seriousness of the remaining 12 accidents can be estimated only from the time the men were off work, and this, as already stated, is not by any means reliable.

John Gentleman, Tasmania Gold Mine, crushed thumb; off work fourteen days.

Wm. Croft, Mangana Gold Reefs, cut on head, stone falling in shaft; four weeks off.

Wm. Goninon, Tasmania Gold Mine, cut on back of hand; off work one hundred and thirty-six days.

George Quinn, Briseis Mine, struck by falling beam; off work four weeks.

John Broad, Tasmania Gold Mine, cut finger; over fourteen days off work.

Frederick Barrett, Tasmania Gold Mine, thumb jammed; over fourteen days off work.

Frank Hudson, Tasmania Gold Mine, burned with sulphuric acid; off work twenty-four days.

Hector Hellesly, Tasmania Gold Mine, finger crushed; off work seventeen days.

Hugh Parish, Tasmania Gold Mine, thumb badly jammed; off work sixty-eight days.

Peter Bews, Tasmania Gold Mine, hand torn by hook; off work twenty-nine days.

George Williams, Tasmania Gold Mine, fingers crushed badly; off work over fourteen days.

Thomas Summers, Cybele Tin Mine, bruises about body; off work over fourteen days.

Of the foregoing accidents, two out of the three fatal ones were due solely to the incautiousness and non-observance of rules on the part of the men themselves; the other, the death of Anderson by drowning was purely accidental, and no person is to blame. It is a coincidence that the accident list,

both fatal and non-fatal, for the past year is exactly the same as for the preceding year, 1905. I am glad to be able to state, however, that more of the accidents for the past year come under the heading of what might be termed "unavoidable," than hitherto. This shows that more care is being exercised both by managers and men.

Accidental Explosions.—Two cases were reported. The first of these was at Fancy Creek Tin Mine, and the cause was not far to seek. William Lucas carelessly threw down a match when spitting fuse and ignited loose powder in a keg close by. The second, however, is not so easy of explanation as to the real cause of ignition. Robert Croft set about charging holes in the face of a cross-cut drive at the 800-feet level in the Mangana Gold Reefs Mine. He placed the first plug of gelignite in a hole 20 inches deep, and pressed it home with a copper tamping-bar, 3 feet 6 inches in length, and weighing 6 lbs. As far as can be ascertained, the hole was of less diameter near the bottom than at the collar. A 2-inch vein of quartz had been bored through a few inches from the bottom, and with the use of a worn drill contraction of the hole would be likely to take place. Croft admits having used some force (a blow, probably) when the plug was near the bottom; and it exploded, sending the bar with great force diagonally against the side-wall. The gelighite (Nobell's) in use at the mine when the accident occurred was found to be in good order. As to the actual cause of the explosion, I am of opinion that the cartridge jammed in the hole, and that compression of the imprisoned air beneath it, causing a rise of temperature, would be sufficient, under the blows of a heavy tamping-bar, to cause an explosion. Premature explosions have been known to occur in this way. A similar explosion to this one occurred at the Volunteer Consolidated Extended Mine, Mathinna, a few years ago. A wooden tamping-stick was being used in this instance; the first cartridge stuck in the hole a foot or so from the bottom, force was used and an explosion occurred, causing rather serious injury to the man charging the hole. In this case it is possible that the walls of the hole got smeared with a thin coating of gelignite, as the cartridge was forced down several inches before the explosion occurred, and that friction of a dirty tamping-stick may have caused the accident.

Under our new Mining Act, 1905, First Schedule, Rule IX., wooden rammers only are allowed to be used when charging nitro-glycerine explosives. In the Mangana accident, however, no breach of regulations was committed by manager or men, as the company happens to be one of the very few mine owners who availed themselves of Section 5, Sub-section 1, of the new Act, 1905, and elected to hold its leases subject to the Act under which they were issued. This being so, they were working under and subject to rules and regulations of an old Act, which allowed the use of a copper tamping-bar when charging any kind of explosive.

Accidents to Machinery, &c.—At the Tasmanian Consols an accident occurred through the breaking of the bed-plate of the old air-compressor engine. It is supposed that a spanner was accidentally allowed to slip in between the end of the cylinder and the cross-head of the piston-rod. A new air-

compressor was being fitted up at the time, and this was finished and got to work without much delay, but unfortunately it did not run long before it broke down. It appears that some mistake was made by the makers; a recess that was not wanted in the inside of the cylinder being filled by a loose plate or piece of iron, which, getting loose, fell so as to come between the piston and cylinder-head, resulting in a complete smash of the latter.

At the Tasmania Mine, in June, the hoisting-rope, with timber shackle attached, was being lowered in the Lefroy shaft, with steam-winch out of gear. The key in the foot-lever of brake jarred out of place, rendering the brake useless; the rope uncoiled off the drum, shearing the knot at end, and fell down the shaft to a depth of 500 feet. Fortunately no damage was done, nor was anyone injured, the men employed retimbering below escaping without injury.

The collapse of about 50 yards of high trestle-work and sluice-boxes at the Transit Tin Mine was not reported by the manager for several weeks after its occurrence. Two men were injured, one slightly and one seriously. Proceedings were about to be taken against the mine manager for not reporting the accident forthwith, but as it was found he had suddenly taken his departure for Victoria, and that the mine had shut down, action was not proceeded with.

At the Weldbrook Tin Mine an accident in every way similar to that of the Transit Mine occurred to the trestle-work and boxes. One man was injured, but this accident was promptly reported. In both cases defective construction was the cause. The foregoing are the only machinery or plant accidents which were reported or recorded in the mine-book of any of the mines under my supervision.

Ropes, chains, shackles, buckets, and shaft-gearing generally, have been inspected, and condemned where found defective. The smaller mines give more trouble in this direction than the larger ones. In the former, 4 windlass-ropes, 1 bucket, and several hooks had to be condemned.

Safety-cages have been tested at regular intervals, generally by the mine manager, whose duty under the new Act it is to do so once in every two months. The inspector is not required by the Act to test cages, nevertheless I do test them on the occasion of each visit, unless the mine test had been made a few days prior to my arrival. Testing cages from the drum, as required by Section 41 of First Schedule of the Act, 1905, has not been found to work very well; to ensure that the safety-grippers shall do their work effectively, should the rope break at the drum, requires a nice adjustment of the springs, together with good skidways of uniform gauge, and a cage well hung. This is not so difficult of accomplishment where speed of winding does not exceed 800 feet per minute, but for faster winding, up to 2000 feet per minute, there is danger of the grippers or safety appliances, through oscillation, over-sensitiveness of springs, and close running, acting when not required to, and causing damage to the cage and rope, and, perhaps, machinery. The Tasmania Gold Mining Company objected or protested against being compelled to have its cages tested in this way, giving as a reason that they anticipated damage to the shafts, buildings, machin-

ery, and winding-ropes, either in making the test, or as a consequence of close-gearing, and sensitive springs arresting the cage when running at a high rate of speed. Tests made by me elsewhere, notably on the New Golden Gate and Tasmanian Consols mines respectively, showed that, although the grippers could be made to work effectively, overcoming the back-drag of rope from the pit-head pulley to the winding-drum, there was still danger of their coming into operation when not required, and thereby causing accident. It was, therefore, deemed advisable to have the last sentence of Rule 41 altered to read, "cages to be tested from the shackle or from the drum, as an inspector directs," and on the recommendation of the Chief Inspector of Mines, His Excellency the Governor was pleased to make this alteration, which came in force on the 2nd day of August, 1906.

Compliance with Rules and Regulations.—On the whole, I cannot say there is any marked improvement in this direction, especially so with regard to both managers and men in the majority of the smaller mines. As far as the owners of some of these are concerned, the managers' excuse for defective equipment is that there is not any money available to get what is required. As for the men, they are not, I am sorry to say, as careful as they should be. Especially is this the case with regard to the handling of explosives; that more accidents do not happen cannot be attributed to the care taken by some men. In the early part of the year two men employed winze-sinking at the 1600-feet level, New Golden Gate Mine, left two plugs of gelignite and some loose caps in the bottom of the winze. At change of shift these were found by men of the relieving shift, and the matter was reported to the manager, who promptly "sacked" the offenders. At the same mine, later on, I found several primers with caps and fuse; also a box of gelignite quite close to the face where two men were working, filling a truck with mullock. The only excuse they offered was that they fired one round of holes, and on returning brought the explosives along with them to charge another set of holes already drilled; but instead of doing this at once they proceeded to truck out the stuff broken by the first round of firing. I would have recommended prosecuting for a breach of the Regulations in this case, only that the manager stated that the offenders were ordinarily careful men, and that he believed what they said as to being under the impression that they were doing no wrong in keeping the explosives by them until they had cleaned up and were ready to fire the remaining number of holes. These cases are illustrations of how careless some miners can be in handling and using explosives. Many other instances could be cited of carelessness of a similar nature, but in a lesser degree, in other mines. In the large mines there is, I am glad to say, an evident desire on the part of managers to comply with the provisions of the Act and Regulations, so far as is reasonably practicable. The men, too, in these mines are beginning to understand that it is to their mutual advantage to comply with the law so far as they are able. If in the smaller mines there is evidence of less care being taken, and a desire to ignore Government rules, it is, I think, mainly due to a want of

knowledge, and perhaps some opposition to new enactments or amendments in existing regulations. Too many prosecutions for offences against the Act are not desirable, and are to be avoided if possible; nevertheless, this means of enforcing compliance must be resorted to, unless there is an improvement in some quarters during the coming year.

New Mines, New Mining Plants, Equipment, &c.—In goldmining, the new mines opened are but few. At Beaconsfield, the Beaconsfield P.A. started on alluvial, near the old West United quartz mine. A tunnel was driven and wash tapped, which was said to be of a good, payable nature. The tunnel passed through the eastern rim rock of what appears to be an extensive deposit of wash, but was not deep enough to bottom or reach the gutter. A shaft is now being sunk.

At the Bonanza Gold Mine, the erection of poppet-heads and a new steam winding-plant was almost completed at the end of the year. The shaft at this mine was sunk during the years 1904-5 to a depth of 600 feet. Haulage was effected by means of a horse-whim, and the men where required to ascend and descend by means of the ladderway. Our new Act, General Rule 22, provides that "safety-cages shall be provided, kept, and used for raising or lowering men in any shaft when and wherever required by an Inspector of Mines." Advantage was taken of this rule to compel the owners of the Bonanza to provide the steam winding-plant referred to. The obsolete practice of sinking by means of horse-whim to depths of over a couple of hundred feet, and requiring men to climb long flights of ladders, or ride on the bucket—a dangerous practice—could no longer be tolerated.

The Tasmania Gold Mining Company has during the year completed its magnificent pumping plant. The fourth unit on west side, at Grubb's shaft, was started on the 6th December, 1906, and like the eastern unit at the same shaft, is working smoothly, and lifting from the 1000-feet level. On the 25th June, 1906, an unusually heavy rainfall took place. Blythe's Creek overflowed the banks of the deviation channel constructed a few years ago to carry its waters past the limestone quarries in Dally's paddock, about 1 mile south by east of the mine. As a consequence of this overflow, and the disappearance of the whole volume of waters into the quarries, the mine became flooded. It was soon discovered that the two pumps (the old one at the main shaft, and the new one at Hart's shaft), working to their full capacity of about 4½ million gallons per day, could not cope with the ever-increasing inrush of water. Large tanks were put to use in the winding compartments in Hart's shaft, and another half-million gallons added to the daily outflow from the mine. Even this was not sufficient, and it was not until the eastern unit of the new pumps at the Grubb's shaft was started that the water could be controlled and eventually reduced in the mine. It had risen to a height of some 15 or 20 feet above the plat at the 818-feet level. Nearly 8,000,000 gallons per day were being pumped in August, and by October the 1st the water was lowered to the 900-feet level, on the 8th to the 1000-feet, and a few days later the men were in these levels, and down to the bottom level at 1100-feet by the 16th. Thus, for sixteen weeks had the surplus water, the result of the overflow of

Blythe's Creek, to be fought before things could be reduced to a normal condition. No hitch occurred, nor was there any interruption from first to last. Everything was well ordered and supervised; the engineers and pit-men performed their duties with skill and judgment, and the result attained reflects credit on the Mine Superintendent, Mr. C. F. Heathcote, and speaks well for the skill and efficiency of the staff and workers under his command. An inspection after the water was got out showed that the mine suffered but little damage from the flooding. Footwall drives constructed at the different levels to take the place of the lode-channel-drives, which were constantly giving trouble through crushing of the timbering, saved the situation this time.

At Mathinna, the Tasmanian Consols Gold Mine has during the year erected new poppet-heads, and installed powerful and complete winding machinery; also an air-compressor. The shaft has been sunk from the 1400 to the 1600-feet level. Mr. A. R. Canning, at one time connected with the management of the Wentworth Gold Mine, New South Wales, and more recently with South African mining, has been appointed general manager of the Tasmanian Consols Mine, and took charge early in November.

Things have been very quiet at the New Golden Gate Mine during the year. A readjustment of finances has, however, taken place, and the shaft is to be sunk a couple of hundred feet, or perhaps 400 feet below the 1600-feet level. This work was commenced early in December.

The Volunteer group of mines on this field has been shut down for a long time past.

Scott and Pickett and the Miner's Dream mines are still working.

The Mangana Gold Reefs Company has sunk its main shaft to 800 feet, and is now engaged crosscutting; also driving on a lode cut in the shaft.

In tin-mining, no new developments of importance have taken place.

The Cybele Mine, at Gladstone, has constructed a barge and centrifugal gravel pump for lifting the wash on the Mussel Roe fall side of its property, and is now engaged in the construction of a powerful steam pumping-plant on the Ringarooma River, about 1 mile above the Esk dam. The object of this is to supply water for sluicing by gravitation from the higher portions of its property.

The Mussell Roe Tin Mining Company is just about completing a head-race 20 miles in length, with an off-take from the Mussel Roe River, just below the intake of the Mt. Cameron Water-race, to bring water on to its mine on the river, 6 miles south-east of Gladstone. The same company has a considerable area of tin ground in the Aberfoyle country, north-east of Gladstone, and a long line of race is being constructed to bring water on to this ground from the Boobyalla River.

At the Blue Tier, the Mount Lyell Company has been carrying out extensive prospecting operations by means of trenching and shallow pit-sinking. The diamond-drills were introduced about 20th August, and have been used freely since that time; results, however, are not made known to the

public. The company has, in the course of prospecting, obtained considerable quantities of tin, which, in addition to the output of several tons per quarter obtained from the Cream Creek sections will materially lessen the cost of prospecting.

The Anchor Tin Mine, by dint of good management, has reduced the cost of mining and milling to such an extent as to show better results than hitherto.

The shutting-down of the Transit Tin Mine, near George's Bay, has added another to the list of failures in tin-mining in the State. This mine commenced operations early in the year. A plant, consisting of a centrifugal gravel-pump operated by a portable engine, was erected for the purpose of raising and treating wash from extensive flats on Constable Creek. The ground is shallow, from 3 to 10 feet. Good prospects were said to have been obtained by the original prospectors, and it was believed that the ground would give splendid results when worked with efficient machinery. The first plant was not powerful enough. Another boiler and a larger pump were obtained at considerable cost, and work was recommenced at the end of August. A few days running, and then a serious interruption occurred, caused through the collapse of about 50 yards of high trestle-work, together with the iron sluice-boxes it carried. The boxes were buckled and spoiled, and had to be replaced by wooden ones. The erection of these iron boxes was a mistake. A couple of months sluicing with the improved plant showed that the ground was not payable. A considerable area was sluiced over, and this included a number of prospecting holes supposed to be in some of the best ground, but the result, on the whole, was not favourable. The mine is now shut down. The collapse of the trestle-work was owing to defective bracing. I had to partly condemn this company's conserving dam, which was in a defective state, and to order that depth of water be reduced, and by-wash enlarged. Heavy rain fell before this could be carried out, and the dam was carried away, happily, without injury to anyone.

Of other new tin mines opened, the Togo may be mentioned. This mine is on Gilligan's Creek, about 3 miles from Avoca. The lode was discovered by Messrs. Trotter and Counsel, and a strong company formed a little over a year ago.

There are several lodes traversing the company's property. The principal one, and that on which most prospecting had been done prior to flotation, outcrops on the top of a spur west of the creek, and was certainly a good show, so far as could be seen near the surface. It was not, however, tested by the prospectors to any depth worth mentioning. Expert reports were obtained, and so well satisfied was the company with its prospects that it was decided to immediately erect a crushing and ore-dressing plant. The Abbotsford Creek battery and engine were purchased and brought on to the ground. In the meantime, extensive work was going on. A tunnel was being driven to cut the No. 1 lode 250 feet below the surface; a large dam was in course of construction, battery-site was being excavated; road-making and other preliminary work in hand; all of which meant a large expenditure of

capital. The tunnel was driven. The lode was cut, but it had pinched, and was not payable. The dam—a large one, 30 feet high—constructed on the creek to supply water to the battery, carried away. This is just what might have been expected; the thing was badly designed, and indifferently constructed. I saw this dam when it was just finished, and pointed out to the mine manager its defects, and that it could not be expected to resist a hydrostatic pressure of 30 feet. The Togo mine is now practically idle. Some prospecting is being done, but that is all.

The Mount Rex Mine has been working the alluvial tin during the year. Further prospecting of the mine proper was resumed in November, driving north from one of the intermediate levels to test the ore-body in that direction.

Gipps' Creek Alluvial is doing fairly well.

Ben Lomond Tungsten.—Mr. Briggs, the proprietor of this mine, is still getting a regular output.

A number of small claims are being worked for tin about the head of Storey's Creek.

At Alberton (North Mt. Victoria), the New River Freehold G.M. Co. has erected a steam winding-plant, and is working a shaft to test one of the lodes on that property formerly worked to some extent by the Ringarooma G.M. Co.

The New Ringarooma Syndicate is getting good returns from No. 5 lode, but is only working in a small way.

Magazines.—The Anchor Tin Mine Company has had a large and well-constructed magazine erected at the mine, capable of storing 3 tons of explosives. The Pioneer Company has also constructed a new magazine, capable of storing 6000 lbs. of gelignite. All the large mines are now well provided with magazines, which are in good order and well ventilated.

Inspection.—I have visited and inspected all the principal mines, both coal and metalliferous, in my districts as often as practicable; generally once in two months for most of these, and at longer intervals for the less important ones; some, in the out-lying parts, once in six months. In September I visited Cox's Bight, on the south coast, with Mr. Twelvetrees, Government Geologist. Special visits had to be made in a number of cases where fatal or other serious accidents occurred.

Ventilation.—The underground mines in the divisions under my supervision are of two kinds, viz., metalliferous and coal. Of the former the number that are now working is 22, with varying depths below the surface of the ground from 50 to 1600 feet, classed for depths as follows:—From 50 to 150 feet, 12 mines; 150 to 300 feet, 4 mines; 2 at 400 and 600 feet respectively; 1 at 800 feet; 1 at 1100 feet; and 2 at 1600 feet; total, 22. All worked from shafts, some of the smaller ones having adit connections also.

The coal mines (9 in number) with one exception (Catamaran) are all worked from tunnels going horizontally beneath the hill, excepting Mt. Cygnet and Sandfly. The former is worked to the dip on an engine-hauling plane; the Sandfly Colliery is also being worked to the dip, but at a much less angle than the Cygnet, which dips at an angle of about 30° from the horizontal. The vertical depths of the workings of

these collieries below the surface of the ground varies from 25 to 500 feet.

Methods of Ventilation in Use.—The metalliferous mines depend almost entirely on "natural" ventilation, aided in some few cases by small "blowers" or by the exhaust from the machine drills worked by compressed air. The result, on the whole, is fairly satisfactory; in some few of the mines exceptionally good—two at least. Separate shafts, or main airways, are required; one to cause the air to circulate from the surface into the deepest part of the mine, "downcast," and the other "upcast," to return it by a different route to the surface. The outlet of the upcast requires to be at a greater elevation above the bottom of the mine than the inlet of the "downcast," for the reason that "natural" ventilation is dependent on or due to the differences of height and temperature of the air-columns in the different parts of the workings. All of these mines, with the exception of the Tasmanian Consols, have the dual shafts or openings required, as nearly all the reefs or lodes worked outcrop and are stoped to the surface, or if not a rise is put up or a second shaft sunk. As already stated, the ventilation is good. In the majority of cases—18 out of the 22—including all the shallower ones and some up to 600 and 800 feet depths, need not for the purpose of this report be further noticed, natural ventilation being all that is required for these, for the present at all events. I will therefore confine my remarks to the three larger mines, which are over a thousand and up to 1600 feet in depth, and to one other (the North Tasmania) which may call for special mention with regard to its ventilation.

The Tasmania Gold Mine, at Beaconsfield, is the largest, but not the deepest of the group. It has three large working and pumping shafts, pretty well in line from north-west to south-east. The first of these, at the north-west end, is the old main shaft, size 6 feet by 14 feet, three compartments, two winding and one pump; its depth is 900 feet. About 330 feet to the south-east of this is Hart's shaft, somewhat larger than the former, and divided into four compartments (cage two, also ladder and pump), its depth being 1100 feet. Then comes Grubb's shaft, 280 feet still further to the south-east. This latter is probably the largest shaft in the Commonwealth of Australia; it is about 30 feet by 8 feet, and has five compartments (two pumps, two cage, and one ladder). It was sunk to a depth of 1000 feet, and connected by a drive with Hart's shaft before the end of 1906. It is now (January, 1907) being sunk to a further depth of 250 feet. In addition to these three large working shafts, there are others for ventilation purposes, viz., the Lefroy, the Florence, and the old Golden Gate shafts. The Lefroy is about 200 feet north-east of Hart's shaft; its depth is 715 feet—minus the difference of surface brace level between this and the main shaft, which is about 20 feet, the latter being on the higher ground. It was recently retimbered from top to bottom of its old depth, 400 feet, and sunk another 315 feet, to bring it down to the 715-feet level of the main shaft, with which it is connected by a drive going out to the junction of the crosscut with lode channel. Its size is 12 feet by 6 feet in clear, no centres, and is used exclusively for ventilation. The surface brace levels of this, Grubb's and Hart's shafts, are even. Old main shaft,

Florence, and Golden Gate shafts, about 20 feet higher. The Florence shaft is 337 feet nearly due north of the main shaft; its depth is 500 feet; it is the principal upcast, being connected by passes down to the 715-feet level at the western end. The old Golden Gate shaft, now being cut down and retimbered, is 375 feet to the north-west of the main shaft. It will be sunk deeper to connect with the 715-feet level, and then used for upcast. The Phoenix, a small shaft in the same locality, used for a long time for mullocking, is now connected by a rise with the 715-feet level. So far, however, the air passing in this shaft is downcast; but this will probably be altered later on, when the scheme for ventilation is complete, as all upcast must then be at the west end of the mine, where the temperature is, on account of the limestone belt and pyritic formation, always much higher than at any other part. From the foregoing it will be seen that this mine now possesses great facilities for ventilating by natural means, and the great improvement effected in its ventilation in the past year or two warrants the assumption that there will be no recurrence of the troubles of the past, when anything like adequate ventilation seemed to be out of the question. As a matter of fact, little or no attempt was made under the old management to improve the ventilation of the mine, which could only be described, when I first made an inspection of it eight years ago, as deplorably unfit for men to work in. There was fairly good downcast, often even more than the regulation quantity per man, but there was no means of regulating the air-currents, not even a single door or piece of brattice cloth in the mine. Men working in winzes, rises, and dead ends could not get anything much short of a stifling atmosphere to work in, and had to be frequently removed to other parts of the mine, to do, very often, unprofitable work rather than that they should lose too much time. In very many cases they lost their health, which was of vastly greater importance than the money they earned. The records of the Beaconsfield Hospital show only too plainly the number of unfortunates who entered there poisoned by the "choke-damp" of the big mine. All this is now, I am happy to say, a thing of the past, and the ventilation of the Tasmania Mine when I inspected it a week ago was, as far as fresh air currents were concerned, all that could be desired. The main shaft, Hart's, and Lefroy were all downcast, delivering nearly 20,000 cubic feet per minute into the mine. Grubb's shaft had its own ventilation, short-circuited, and independent of the other three, or, more correctly, of Hart's and Lefroy shafts, as the main shaft was partly upcast and would have been wholly so had not the return been shut off at the 715-feet level. Temperatures taken with dry bulb thermometer were as follows:—At surface brace of main shaft, at 9.30 a.m., 70° F.; at 715-feet plat of same shaft, 78°; inside air down at bottom of Lefroy shaft, same level as foregoing, 66°; west of crosscut at same level, 76°; still further west, in limestone belt, 86°. Near to this latter place two men were at work, driving a short crosscut to facilitate the working of the mullock run in the limestone and to get better circulation of air. The temperature in face was 90° F., in an apparently dry heat. These men were perspiring freely, but evidently not much distressed. The great heat in this place, as compared with other parts of the mine, has its uses in assisting the return air current. Quite one-third of the air

circulating in the mine passes along this 715-feet level west, and ascends by a pass to the Florence upcast shaft. Temperatures in the bottom levels of the mine on the same day did not exceed 70°, which was to some extent phenomenal, as this was the surface temperature at the same time. The velocity of the air, 17 feet per second, passing through the flood-gate at the 1000-feet level may have had something to do with it. Natural ventilation under the most favourable conditions cannot be depended upon to meet every requirement in the circulation of air in a big mine. There are always places in developmental work, such as rises, winzes, and dead ends, which require mechanical means to ventilate them. This can be done in a variety of ways, such as by means of a small fan driven by electricity, compressed air, or even water where the latter in wet mines is sometimes passed down from a higher level to the bottom pumping station. A jet of water can also be used to blow air through a pipe into such places. Where machine drills driven by compressed air are used, the exhaust materially assists in ventilating the fall; but this is not much liked by miners, who hold that air from the compressor is inferior for breathing purposes. That it is at times objectionable there can be no doubt. This is probably due to the oil used at the compressor and condensed moisture in the air compressed accumulating for a time in low-lying parts of the air main, or in the reservoir, and becoming very foul, affecting the air blown off through the drills. Analyses, however, made by Messrs. Haldane, Martin, and Thomas, of compressed air in Cornwall, also by Mr. E. A. Mann, Chief Inspector of Explosives, West Australia, and by the Victorian Bonus Board on Ventilation, all go to show that the air from compressors is practically pure. No rock-drills are in use at the Tasmania Mine.

The two deepest mines in the State are at Mathinna, viz., the New Golden Gate Gold Mine and its very near neighbour, the Tasmanian Consols, both sunk to a depth of 1600 feet from the surface. The "Gate" mine has a single working shaft of rather small dimensions, divided into three compartments, two cage and one ladder; it has also pass and rise connections from the bottom levels right through to the surface, which act as an airway. There are in all 17 levels in this mine, and it has been worked on an extensive scale for many years past, giving good, payable results. Unfortunately, however, it has not been doing so well for the past year or two, the deeper levels not proving payable. At the present time the shaft is being sunk below the 1600-feet level and will probably be put down to 2000 feet. Ventilation is by natural means, aided to some extent by compressed air from the mains of the rock-drills used in the mine, and has been fairly adequate, but never very good. The mine is a dry one, very much so down to the 1400-feet level; even now a small electric pump suffices to keep the water out of the bottom levels. The cold air passes into the mine by an adit 50 or 60 feet below the level of surface brace of main shaft, and also by a small air-shaft further south, which is downcast, the combined currents from both these sources circulating downwards through the workings, the main shaft being upcast. It would be much better if the air circulation was the other way about, and that the downcast were through the main shaft, as this is the principal travelling way by which men enter or leave the mine.

There is, of course, a means of escape through the passes and rises to the surface, but in the case of fire in the mine or fumes arising from any cause it would be unsafe to depend on this means of exit, and in all probability exit by the main shaft would be cut off, owing to it being upcast and the smoke or fumes passing in that way. The mine, owing to its extreme dryness, was often stale and unpleasant; sanitation not too good either. A good wash out would be beneficial.

Tasmanian Consols.—This mine adjoins the "Gate" property on the north side, the two shafts, Consols and Gate, being only 50 yards or so apart. It is down to the 1600-feet level; the last sink of 200 feet was completed at the close of the year 1906. There is only one shaft, and this is the only means of entrance to or exit from the mine. The working levels are from the 1200-feet downwards; no stoping has been done above this. Short levels were driven for prospecting purposes, but no connections made. The shaft is of fairly large dimensions, and divided into three compartments (two cage and one ladder). New poppet-heads have recently been erected; also a powerful steam-winding plant and large air-compressor. The ventilation is "natural," and on the whole fairly adequate. The workings are not extensive, extending only some 150 feet to 200 feet north of the shaft, and on the south side about 50 feet to the boundary between the two mines. The mine is fairly dry, bailing occasionally being sufficient to keep the water out. Rock-drills are in use, and air from these helps ventilation considerably. Although fairly satisfactory so far, it is not likely that this mine can continue to work at such a depth when its works are more extended without being provided with some mechanical appliances for ventilation, or a connection with the surface apart from the main shaft. The difficulty can be got over by connecting the two mines, this and the "Gate," as provided for under "The Mining Act, 1905." This could be done without any great outlay on either side, and would prove beneficial to all parties concerned, not only so far as ventilation is concerned, but also as a means of escape for the men employed. The "Gate" mine, too, will, in the event of payable stone being struck at the deeper level now being sunk to, have to provide more adequate ventilation, the downcast air at present passing through the old workings, where there is so much decaying timber, cannot be expected to be anything like pure. If the upcast were in this direction it would not matter.

There is one other mine in the metalliferous group which I desire to mention; that is the North Tasmania, at Beaconsfield. It is 400 feet in depth, with a well-timbered shaft, and now equipped with a steam-winding plant. There are the workings, levels, and a connection with the surface from the top one of these by means of an underlay shaft. For many years past this mine has been worked off and on by a few men, not more than four at any time. The ventilation is seldom good, as the country-rock here, as at most of the Beaconsfield mines, is charged with gas (carbon-dioxide), which exudes freely at times, perhaps after the firing of a shot or when fresh rock surfaces are exposed. A small blower is employed to help ventilation, but this is almost useless. Men, tributers as a rule, only make half-time at best, as for days at a time there is no getting into the mine on account of bad air. This mine is certainly not provided with an adequate

amount of ventilation, but it is not easy to enforce compliance with the Regulations under existing circumstances.

Coal Mines.—The two principal collieries, Mount Nicholas and Cornwall, are ventilated by separate return airways connecting with upcast furnace shafts.

The Mount Nicholas Colliery is worked on the "long-wall" principle, the farthest in workings being about three-quarters of a mile from the entrance of the tunnel; the seam is 4 feet. The air, after circulating through the different places, which are all connected with each other, returns to near the surface entrance by a separate drive connecting with the furnace shaft, and escapes to the surface. Fairly good ventilation is maintained in this way, so long as the return airway is kept clear of obstructions and the furnace is properly attended to, but if these are neglected, and they sometimes are, the state of the ventilation soon becomes bad. Latterly the ventilation has not been very good, on account of the frequent faulting of the seam interfering with the continuous line of face, and consequent obstruction of the air-current. The old workings will now soon be abandoned, on account of the faulting referred to. A new tunnel is being driven to open up another part of the tunnel seam (4 feet) further west from the old tunnel entrance.

Gas.—The only gas to contend with in the ventilation of our coal mines is carbon-dioxide, or, as it is commonly called, carbonic acid gas. There is no fire-damp, methane, or explosive gas, at least none discovered so far, excepting in one instance of recent occurrence, reported by the manager of the Sandfly Colliery, but this was of so slight a nature as to be scarcely worthy of notice. Further search is however being made in the daily inspection before work. This being so, the methods of ventilating are practically the same as in the metalliferous mines, as a gas of the same nature has to be dealt with.

Under our Mining Act, 1905, "an adequate amount of ventilation, that is to say, not less than 100 cubic feet of pure air per minute for each man and boy, and not less than 150 cubic feet per minute for each horse, employed underground in a mine, excepting in cases where noxious gases exist to a dangerous degree, when the quantity of air required shall be increased to 500 cubic feet respectively, shall be constantly produced in every mine, to such an extent that the shafts, winzes, levels, underground stables, and working places of such mine shall be in a fit state for working and passing therein." Two things have therefore to be considered, quantity and quality of the air supplied. To ascertain the first of these, quantity, an instrument, an anemometer, is used for measuring the velocity of the air current circulating in the mine. This can be done with a certain degree of accuracy where large or fairly large quantities of air are passing, but for velocities under 1 foot per second it is doubtful, and under half a foot totally unreliable, as I will explain later on. I must first refer to the ventilation of the Cornwall Colliery. This colliery is ventilated by artificial means in exactly the same manner as that described for the Nicholas Mine, viz., by a separate return airway and upcast furnace shaft. Its workings are, however, on a different principle, being the method known as "pillar and bord," which means that a certain amount of

coal in the shape of rectangular blocks is left in the mine to support the roof. The spaces worked out between these blocks or pillars is called a bord. The main heading, that is the main working road, whether leading from the bottom of a pit or shaft, or, as in this case, a tunnel from the surface, is also always the main intake for ventilation. There are also cross-drives from this, and again back headings running parallel to it; from these latter the bords are turned off, with a narrow entrance, generally 6 to 8 feet, but immediately opening out to the full width, which is as a rule about 8 yards, and for length extending through to the next back heading, a distance of from 22 to 28 yards. The difficulty of getting air to circulate in such places as these is not easily overcome. The Cornwall Company for several years, and before the works extended so far beneath the hill, managed to have fairly good ventilation; but now that the farthest workings are nearly a mile in from the entrnce of the tunnel, and that settlement of the roof on the coal pillars is causing a "creep," or rising of the floor of the worked out ground, and consequent damage to the return airway, the circulation of air is not what it should be, and at times is far from being "adequate" within the meaning of the Regulations. The company has lately completed the installation of an electric hauling plant, for bringing the coal out of the mine. This will improve matters somewhat, as the horses formerly employed for this purpose raised much dust and otherwise interfered with the ventilation. I have frequently during the past year pointed out to the manager of this colliery the necessity for improving the ventilation, the first step towards which should be the enlarging, straightening, and generally improving the return airway. Something has been done in this direction, but not enough. The furnace, too, requires a large grate surface, and a better arrangement for draught. Referring again to the use of the anemometer, I may point out that in mines such as the above this instrument is almost useless for measuring any but the principal air currents. As an instance, take one of the bords referred to: the gate openings or entrance to these generally represents an opening of 40 square feet area. Two men are working within the bord, and it is desired to ascertain if they are getting the regulation quantity of 200 cubic feet per minute, which would mean a register by the instrument, in an area such as this, of 1 inch per second, a velocity altogether too low to even move the vanes on it. As a matter of fact, any velocity less than 6 inches per second cannot be taken as reliable on these instruments. The only way out of the difficulty is to apply the purity test, which after all is of more importance than quantity, so far as our mines are concerned, as the only gas to be dealt with in both metalliferous and coal mines in this State is carbon-dioxide (CO_2). In his special report as a member of the Royal Commission on the Ventilation and Sanitation of Mines in Western Australia, 1905, Mr. Mann describes the methods employed in testing for the presence of different gases found in mines, and refers more particularly to the use of the bottle test for estimating the CO_2, which he says could be readily applied by inspectors of mines who have not had any special training in chemical manipulations. This is, I understand, the method used officially in Victoria, where the purity test is required

apart from any question of quantity. In "The Mines Act, 1904," of that State it is prescribed that the carbonic acid shall not exceed ·03 per cent., or three pints in one thousand by volume, which is a little less than eight times the amount of this constituent normally present in the surface air (0·04), and that the oxygen shall not be less than 20 per cent. by volume, the surface air normally containing 20·96 per cent. Of course any test made for either purity or quantity should be such as could be sustained legally, otherwise enforcement of compliance could not be insisted on.

Of the remaining seven coal mines, the Sandfly is the only one of importance that is likely to develop into a fairly large colliery. The method of working is, for the present, "pillar and bord," same as the Cornwall, but it is, I understand, intended to work on the long-wall system as soon as the works get further in. Ventilation so far is by natural means.

Sanitation of the mines generally is fairly good. Pans and latrine accommodation is provided in most cases, in the big mines especially. It is not, however, so easy to get the smaller ones to observe the rules in this direction.

LIST of Accidents in Inspector Griffin's District for Year 1906.

Fatal, 3 ; non-fatal, 28 ; total, 31.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1906. 9 Jan.	Tasmania Gold Mine	Beaconsfield	Something dropping down shaft	Page, Ernest	Single	Loss of one eye	Was using knocker line in Grubb's shaft, and was struck in the eye by a particle of something dropping down shaft. Eye had to be removed
20 Jan.	Mutual Hill Tin Mine	Derby	Caught by boulder from slip	Ratcliffe, Oscar	Ditto	Bruised ankle and contusions about hips	Was working in open-cut face ; a fall of earth took place, boulder caught him on the ankle, and rolled over his body.
22 Jan.	Tasmania Gold Mine	Beaconsfield	Stone rolling jammed his thumb	Gentleman, John	Married	Thumb badly crushed	Was working in the 500-ft. chamber, Grubb's shaft; stone rolled and jammed his thumb ; was off work 14 days.
28 Feb.	Mangana (Tas.) Gold Reefs Mine	Mangana	Small stone falling down the shaft	Croft, Wm.	Single	Severe flesh wound on forearm	Was working in the shaft ; a small stone fell from some height, striking him on the arm and inflicting wound.
21 Mar.	Ringarooma Bucket Dredging Co's. Mine	South Mount Cameron	Accidentally falling off plank into water	Anderson, Wm.	Ditto	Suffocation	Was employed wheeling gravel on to deck of barge 12 feet from the bank ; went forward on plank to trim heap, missed his footing, fell into the water, and slipping beneath the bottom of dredge, was drowned.
2 April	Tasmania Gold Mine	Beaconsfield	Stone falling off truck	Goninon, Wm.	Married	Bad cut on back of hand	Was helping to fill stone into a truck in Grubb's shaft ; a piece rolled off and caught him on the back of his hand, inflicting a severe wound

5 April	Briseis Tin Mine	Derby	Collapse of a trestle	Quinn, George	Married	Injury to small of back	Was assisting to erect trestle-work; a bolt gave way, and a piece of the bracing fell on him; was off work about 4 weeks.
12 April	Sandfly Colliery	Margate	Fall of ground in heading	Hall, Thomas	Single	Broken leg and bruises	Was with his mate driving heading; work was carried forward on "canch" or jump up of floor; short props were used on one side and slipped, letting portion of roof down. Hall was caught and injured.
27 April	Anchor Tin Mine	Lottah	Jumping off a truck in motion	Kelly, R.	Married	Broken collar-bone	Was riding on a truck hauled by a horse on incline; truck became detached, and ran back; Kelly jumped off, and broke his collar-bone in falling.
2 May	Tasmania Gold Mine	Beaconsfield	Foot caught in tram-rail when running truck	Spurgo, Horace	Single	Fracture of small bone of leg near ankle	Was engaged trucking at 1000-ft. level; got his foot caught in tram-line, and broke small bone of leg; was off work 7 weeks.
7 May	Ditto	Ditto	Fall of quartz in big stope	Dunstan, James	Married	Both legs broken below the knees	Was assisting to lift a long cap-piece into place; a large mass of quartz fell from the backs close by; other men escaped, but Dunstan was caught by rolling stone.
9 May	Ditto	Ditto	Ascending on bucket, head struck projection in shaft	Waters, James H.	Ditto	Severe cuts on head	Was ascending on bucket with his mate in the Lefroy shaft; bucket swung to the side, and his head came in contact with projecting plank at side.
14 May	Ditto	Ditto	Piece of stone falling from backs	Broad, John	Ditto	Cut through sinews of first finger	Was working in stope picking down from back, piece of quartz struck him on wrist severing sinew of fore-finger; was off work 24 days.

LIST of Accidents in Inspector Griffin's District for Year 1906—continued.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1906.							
4 June	Tasmania Gold Mine	Beaconsfield	Loading timber, got thumb jammed	Barrett, Frederick	Single	Thumb badly crushed	Was helping to load heavy timber on to a trolly; got his thumb jammed; was off work 7 weeks.
4 June	Ditto	Ditto	Caught by descending cage	Cairns, Wm.	Married	Severe cuts on chin, teeth, and portion of jawbone knocked out	Was engaged as platman at 400 ft. level "Capstan division" Hart's shaft, got catches damaged, and attempted to repair them; cage decending, struck him. Died 5 days later.
6 June	Ditto	Ditto	Splash from sulphuric acid	Hudson, Frank	Single	Burns on face about eyes	Was lifting a jar of sulphuric acid, handle broke, and acid splashed over his face, injuring his eyes, but not permanently.
6 June	Anchor Tin Mine	Lottah	Stone falling from open-cut face	Herrick, James	Married	Cut on head	Was drilling a hole at foot of open-cut face. A small stone fell from some height and struck him on the head; off work 4 weeks.
13 July	Cornwall Coal Mine	Mount Nicholas	Coal-skip leaving rails on incline	Nichols, Wm.	Ditto	Injuries to chest, lungs, and bowels	Was riding on a loaded coal skip descending self-acting incline; a box he was holding slipped, and threw him off, causing injuries from which he died the next day.
31 Aug.	Briseis Tin Mine	Derby	Pipes rolled	Hellessy, Hector	Single	Top of one finger crushed off	Was loading pipes on to a trolly when he got his finger jammed; was off work for 17 days.

4 Sept.	Transit Tin Mine	George's Bay	Collapse of trestle-work	Hodges, Wm. Geo.	Married	Shock and injury to spine	Was at work on elevated sluice boxes, the trestle-work supports of which gave way; he went down with the boxes, and was injured.
12 Sept.	Tasmania Gold Mine	Beacons-field	Timber being lowered	Parish, Hugh	Ditto	Finger jammed	Was assisting to lower timber in shaft, got his finger jammed; was absent from mine 68 days, but not altogether on account of accident.
22 Oct.	Weldbrook Tin Mine	Weld-borough	Collapse of trestle-work	Breen, John	Single	Shock and bruises on back	Was employed as sluiceman working on elevated box-race; trestlework gave way, and he fell with boxes, and was injured; was off work over 14 days.
2 Nov.	Tasmanian Gold Mine	Beacons-field	Hand caught on hook of machinery	Bews, Peter	Married	Nasty torn wound on palm of hand	Was cleaning drip-tins on pump-bob, got his hand caught on hook; was off work 29 days.
5 Nov.	Fancy Creek Tin Syndi-cates Mine	Weld-borough	Explosion of powder	Lucas, Wm.	Single	Burns on hand and arm	Was charging a hole with powder when spitting fuse ignited loose grains of powder round collar of hole, and exploded 5 or 6 lbs. of powder close by.
12 Nov.	Tasmania Gold Mine	Beacons-field	Stone fall-ing down pass	Hunkin, Joseph	Married	Small bone of left arm broken	Was running a pass, a stone fell on his left arm, breaking small bone.
24 Nov.	Burnie Copper Mine	Blythe River, Burnie	Boulder rolling	Breen, M. J.	Single	Fracture of small bone of leg above ankle	Breen was working in open-cut excavation; used his pick to loosen a boulder, which came away suddenly and caught him on the leg.
27 Nov.	Mangana (Tas.) Gold Reefs Mine	Mangana	Explosion of gelig-nite	Croft, Robert	Ditto	Burns and slight laceration of arm	Was charging drill-holes with gelignite; used a heavy (6 lbs.) copper tamping-bar; used some force when pressing first plug home, causing it to explode.

LIST of Accidents in Inspector Griffin's District for Year 1906—continued.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1906.							
30 Nov.	Tasmanian Consols Mine	Mathinna	Fall of rock in shaft	Peden, Thos. Gordon	Married	Fracture of right leg bone above ankle	Was engaged shaft-sinking; neglected to test ground after shots had been fired. A large piece of rock slipped from side and struck him.
12 Dec.	Tasmania Gold Mine	Beaconsfield	Caught by slide-block of engine	Williams, Geo.	Single	Hand crushed, top joints of two fingers had to be removed	Was lagging cylinder of pumping engine at Grubb's shaft; placed his hand on guide-bar, and slide-block coming back, crushed it.
20 Dec.	Ditto	Ditto	Fall of rock breaking cap-piece	Williams, J.	Married	Cut on head and bruised leg	Was working with T. Cowie in stope block 54. Eased a large lump of quartz which came away—breaking cap. He fell 7 feet and was injured.
28 Dec.	Cybele Tin Mine	Gladstone	Fall of earth in open-cut	Simmons, Thomas	Single	Bruised about hips and back	Was deepening a tail-race when a portion of side-wall (decomposed granite) slipped down and caught him.

Mr. Inspector Harrison (stationed at Zeehan) reports:—

In submitting my annual report for 1906, I beg to state that the accident list was 1 fatal and 9 not fatal; a few of the latter were not of a very serious character.

Safety Appliances.—All the principal mines are well supplied with the necessary safety appliances, to avoid accidents.

Hoisting Ropes and Cages.—Several hoisting ropes have been condemned during the year. The cages have been tested at intervals, and when necessary sent for repairs.

Ventilation.—Ventilation in the mines is, on the whole, very good. Most of the managers are able to depend on natural ventilation, except when breaking through from one level to another, when other means are adopted.

Magazines.—Magazines, which are now 32 in number, are kept clean and in good condition. Ten of these are used for storing explosives for sale. A better system of importing explosives *viâ* Strahan is badly required.

Health of Employees.—The health of the miners will compare most favourably with any mining field in the Commonwealth. At the local smelters special arrangements have been made for doing away with the bad fumes, and cases of lead-poisoning are not nearly so numerous as formerly.

Prospects of the Field.—In nearly every direction the district is going ahead. At Heemskirk and North-East Dundas the output of tin is steadily increasing. At Mt. Read, Mt. Farrell, Rosebery, and the Henty River mining is going on most energetically; while in Zeehan proper several new mines have been started, which are adding to the output. At the Stanley River, I regret to say, that with the exception of a little prospecting by hand bores in the alluvial flats, nothing of consequence has been done, and this valuable tinfield is practically locked up.

Ventilation.—The systems adopted are as follow:—Natural ventilation, air compressors, blowers, and water jets.

Our deepest mines are only about 800 feet down, and I am pleased to state natural ventilation has been found quite sufficient in them, except in rising from one level to another or in putting in prospecting drives, when either a Root's blower or water jet is put in position. Some of the mines are fitted with air-compressing plants, but as they are seldom used for boring purposes (country not being sufficiently hard to require them), they are kept in readiness for ventilation, if required.

The lodes are not of a warm nature, the metal (galena) is usually damp, and there is an absence of dust.

In my opinion, air-compressors are answerable for a large percentage of the sickness amongst miners. The oil from the air-cylinders becomes impregnated with the air, and the air-receivers are generally in a filthy condition through the same cause. Where air has not to be carried any great distance, say, from 6 to 800 feet, I am a firm believer in the water jet, as the miner then obtains his supply cool and sweet. But natural ventilation, if possible, is best of all.

LIST of Accidents in Inspector Harrison's District for the Year 1906.

Fatal, 1 ; non-fatal, 9 ; total 10.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1906.							
10 Mar.	Tasmanian Copper Co's. Mine	Rosebery	Fall of ore	Jones, Joseph	Single	Injured shin bone	Was barring down ore at surface when a piece struck the bar and forced it against his leg.
3 June	Florence Silver Mine	Zeehan	Fall of rock	Moyle, Wm. Thos.	Ditto	Crushed toe	Caused by fall of rock from side of drive.
25 Aug.	Zeehan-Queen	Ditto	Fall of bucket	Ledwell, Albert	—	Scalp wound	Bucket fell down shaft and struck him on the head.
15 Sept.	Tasmanian Smelting Co's. Wks.	Ditto	Fall of stage	Howe, George	Single	Cut head and broken nose	Was working as a carpenter when the stage on which he was standing broke.
11 Oct.	Austral Valley Silver Mine	Ditto	Oiling machinery	Smith, Chas.	Married	Lacerated arm	Caused while oiling water-wheel.
13 Oct.	Tasmanian Copper Co's. Mine	Rosebery	Fall of ore	Headlam, Allan B.	Ditto	Internal injuries	Fall of rock, crushing body badly. He lived 24 hours.
29 Oct.	Tasmanian Smelting Co's. Wks.	Zeehan	Fall of converter pot	Henderson, John	Single	Crushed foot and injury to leg	In filling converter omitted to secure it by stay.
1 Nov.	North Mt. Farrell Silver Mine	Tullah	Fall of rock	Herron, John	Married	Bruised ankle and face	While securing face, rock fell.
13 Nov.	Tasmanian Smelting Co's. Wks.	Zeehan	Fall of furnace door	Johnstone, N.	Single	Crushed toes	Furnace door fell on his foot.
6 Dec.	Mt. Bischoff	Waratah	Caught between two trucks	Linachner, Hector	Ditto	Wounded shin	Caused by being caught between two trucks.

Mr. Inspector CURTAIN (stationed at Queenstown) reports :—

In furnishing a summarised report on the inspection of the mines and works of this district for the past year (1906), I beg to particularise items as under :—

Casualties.—Mount Lyell Mining and Railway Company, Limited.—Barclay Wheldon, age 39 years, married, a feeder on the middle floor at the reduction works, had his right hand crushed by a skylight blowing out and falling on him, and his forefinger had to be amputated.

Stanley Brown, aged 18 years, single, a filler on the same feed-floor, had his left thumb crushed (necessitating the loss of two joints) by a piece of limestone falling through the ore-bin.

Sylvester Casey, aged 23 years, single, a vessel-man at the converters, had his neck and shoulders burned by an internal explosion or overthrow of matte from No. 2 converter. He was idle for 14 days.

William Howe, aged 21 years, single, a trucker at the 600-feet level of the North Lyell Mine, lost the middle finger of his right hand by a truck bumping off the line and jamming his hand against the "lip" of a chute. He was idle 19 days.

Thomas Menadue, aged 33 years, single, a blacksmith's striker, while cutting a rail at the converters, lost the sight of his right eye by a "splinter." He was idle for 75 days.

Walter Hewitt, aged 24 years, single, while working in bench IYB at the "Blow," lost the sight of his right eye by a spall from a fellow workman's hammer entering and destroying it. He was idle 92 days.

Edward Estcourt, aged 33 years, single, a carpenter, engaged renewing the roofs at the reduction works, stepping on a sheet of perished iron, fell through and broke his jaw. He was 56 days idle.

Ellis Blomquiest, aged 29 years, single, a converter-hand, was connecting or joining a vessel, when its crown, which was suspended, swung round and jammed his right leg against the woodwork of the stand, severely cutting and bruising it above the ankle. He was idle 112 days.

Charles Mantick, aged 32 years, single, a labourer at the reduction works, was assisting to clean the main flue behind "No. 7," when a quantity of heated dust fell on him and burned his face, arms, and feet. He was idle 41 days.

James Harrington, aged 46 years, married, head yardsman on the top of the main haulage, was "shoeing" a rope, when the "white metal," while being poured into the socket, exploded, and receiving the charge on his forehead and eyes, the latter were permanently injured. Since the date (1st July) of the accident, which was the most serious in the district, Harrington has been incapacitated, but with the assistance of the company he has been enabled to open a boarding-house.

John Lydon, aged 34 years, single, a ganger in bench IY at the "Blow," put a pick into an old hole, when an explosion followed, which, in addition to inflicting wounds on his body, injured his eyesight, which necessitated his visiting Victoria. He was 109 days idle, and has again resumed his usual duties at the mine.

Richard Morley, aged 35 years, married, a head furnace-man, was assisting to remove a water-jacket from "No. 7," when it

slipped into a trough or furnace-well, and a connectin shoulder striking the crowbar which he was holding, caus its end to rebound and inflict the injuries stated. He w idle 35 days.

Henry Ward, aged 51 years, married, a stoker at the co verter boilers, had his right eye permanently injured by o of the water-gauge glasses of the boiler bursting. He w idle 12 days.

Arthur Cæsar Cocks, aged 20 years, single, a tipper on t aerial terminus at the reduction works, fell into an empty bi and sustained a general shaking and bruising, which incapa tated him for 34 days.

Edgar Walshe, aged 30 years, married, a mechanical ha at the reduction works, was assisting to skid a lift-shaft, wh a board erected as a platform to hold his lamp fell, owing the lift coming in contact with it, and produced a scalp wou which incapacitated him for 18 days.

Benjamin Dawson, aged 29 years, married, had his right e injured while working in the stopes of the Lyell Tharsis Mi by a flying "spall" from his mate's hammer. He was only ic 13 days, but his eyesight is still impaired.

William Frederick Grant, aged 30 years, single, while wo ing with an emergency gang at the No. IYA bench of the "Blow had the small wrist-bone of his right arm broken while barrin down. The "crust" over an old rise which he was working collapsed, and he fell with it. He was idle for 10 days, wh the company found light employment for him as a signalm on the "incline" hoist-shaft.

Robert Phillips, aged 29 years, married, a casual on t haulage, was employed on the 12th of December filling aer buckets at the mine end, when a loaded one, of which he h charge, left the main travelling rail, and toppling over hi inflicted bruises and cuts on his back and neck. Though c valescent, he has not yet returned to work.

Lyell Blocks Mining Company, No Liability.—Martin Char Aitchison, aged 26 years, married, a shoveller, while assisti to place a heavy "blocking-out" cap in position, had l back and shoulder bruised by it falling on him. He was ic 15 days.

Thomas William Dann, aged 57 years, married, while havi "crib" in "No. 1," had his right leg broken above the anl by an unprotected piece of the roof coming away and falli on it. He was idle 136 days.

Frederick Temple Dingle, aged 34 years, single, a stope c tractor, sustained a sprained ankle and bruised knee by falli through an incline pass which he and his mate had neglect to protect. This accident happened on the 17th of Septemb and some time later Dingle left Lyell to seek further medi advice. The most recent information respecting him is th he is working at the Glassfoot Creek Copper Mine, Miriam Va Queensland.

Thomas William Scallan, aged 42 years, single, a gene hand, while proceeding to his place of work along an "int mediate" level, walked into an open and unprotected pa and dislocated his left collar-bone. He was idle 13 days.

James Cumming, aged 32 years, married, a repairer, unc sciously walked into a pass he had been using. It w

obscured by smoke arising from a round of stope-firing. He fell about 25 feet, and in addition to a rough shaking, sustained a bruise to his right elbow, which kept him idle for 30 days.

William Stephens, aged 41 years, single, was injured by a fall of a piece of clay from roof, inflicting bruises to hips and back.

In addition to the foregoing there were other accidents of a minor degree, which need no enumeration in this category. But against these, however, there are others which, having incapacitated the injured persons much beyond the stipulated period, as stated in Section 181 of the Act, and though relating chiefly to finger and toe injuries, should have been at the time of their occurrence reported; and for this reason I would recommend that Sub-sections 2 and 3 of this Section be so amended as to make it obligatory on the part of the manager or his representative to notify the local resident inspector, in conjunction with the medical officer, of all casualties of this nature.

Dealing with the mines generally—probably, with one exception—they are working well within the limits of safety, and with proper surveillance should continue so. Unforeseen circumstances may arise, but the dangers arising from "soapy heads," "baulked ground," unprotected "swinging backs," and "sides," &c., are vanishing.

Next in importance to the safety of the workings are the appliances whereby the men are assisted to reach their place of work. Owing to the number of men now residing in Queenstown who work at the mines, the main haulage is much requisitioned. As many as 50 men travel, and at times make a load which is too many, and therefore the number should be regulated, and restricted to not more than 35 in each empty rake of 5 trucks, or 7 passengers to the truck, which would not overtax the accommodation. The rope is an approved 4½-inch wire one, with a breaking strain of 80 tons. Its most vital part is under frequent, if not constant, examination, and before half its life is exhausted it is transferred to the mine, or opposite side, where little or no riding is permitted, and is replaced with a new one.

Ropes and Cages.—At the North Lyell Mine, eight inspections, dealing with 32 ropes and 6 cabes, have been made and recorded. In the majority of cases they were satisfactory, but instances have occurred in which, after the cage had been detached, it fell away, and was only arrested by the barricade, clearly demonstrating the necessity of constant attention to the efficiency of the safety appliances, as on examination it was invariably found that the fault lay with the springs being too slack, or the gripper points requiring to be cleaned. One "poppet-header" was recorded against a winch-driver, and its occurrence exemplified the efficiency of "Middleton's safety hook," which, in unison with the grippers, acted satisfactorily. The ropes in use are full 2¾-inch approved steel, and in ratio to their loads possess the required margin of safety.

Brakes and Mechanical Gearing.—I have rarely anything to do with these, as their inspection devolves upon the Inspector of Machinery.

Signalling.—A system of electrical gong-signalling, coupled with a corroborating or simultaneous "flashlight," has been introduced and installed at the North Lyell Mine. Its use is solely restricted to those having the cage directly under immediate command, and in no instance must it be used as a call or requirement knocker. The latter is relegated to a distinctly separate telephone service, with which each plat is provided.

Ladders throughout the main entrances fulfil the requirements of the Act; well-seasoned turned hickory taking the place of iron rungs, which are too susceptible to the deleterious influence of our highly mineralised water.

Ventilation.—Only in rare cases, and principally while connections were being made to provide it, has the air been found "sluggish," its general condition in all mines being from fair to excellent, and would compare favourably with the best mines I visited in the neighbouring State.

Sanitation.—One mine has introduced the pan system underground, which may be regarded as satisfactory there being only one occasion in which exception had to be taken to the want of deodorants. Repeated requests have been made to keep the underground workings free from waste food and crib wrappers. The men, in a measure, are somewhat blameless, as there are no suitable and convenient receptacles provided to receive this general waste and nuisance.

Explosives.—Complaints have been received respecting certain brands of explosives, but if these complaints have any valid foundation the fault lies in permitting the "brands" in question to enter the State, for once in circulation it is impossible to prevent their use on the mere assertion of persons who know nothing about their composition, and may be prejudiced against the "brand." An instance came under my notice, when a firm of manufacturers of world-wide repute happened to change the colour of each cartridge wrapper, and the consignment, though warranted free from any deleterious ingredient, was condemned throughout the district. The men, believing they were being poisoned, cited cases of sickness (feigned or otherwise) as having taken place amongst them; so that, in dealing with this matter, great caution has to be exercised.

Explosive Magazines have been inspected periodically. Those in use are clean and satisfactory.

Inspections.—The mines and works herein stated have been visited as follows:—Iron Blow—surface 45 times, underground 4 times; North Lyell—surface 35 times, underground 42 times; Lyell Tharsis—surface 22 times, underground 31 times; Lyell Blocks—surface 40 times, underground 40 times; Flux Quarries—surface 5 times, underground 30 times; Tasman and Crown Lyell Extended—surface 37 times, underground 4 times; Copper Mines of Mt. Lyell West—underground 7 times; Lyell Consols—surface 5 times; Woody Hills—surface 7 times, underground 7 times; May Gold Mine—surface twice, underground 8 times: Antimony Sections—surface 3 times, underground 7 times; Crown Lyell—surface twice; Jukes Proprietary—surface 4 times; Comstock Tasman—surface once; Oonah Mine—

surface 7 times; Austral Valley—surface once, underground once; Reduction Works—surface 30 times; Concentrators—surface 8 times.

Gold.—Quartz-mining has been restricted to prospecting at Woody Hills and May's Mine, at Lynchford, with, in both instances, unprofitable results, which also applies to Darwin, and similar work done in its immediate vicinity.

Alluvial.—A fair quantity of gold has been obtained from Darwin, Owen, Queen River, Coronation, and Flanagan's Flats; but the work is pursued in such a desultory manner that no better results could be expected. Those so employed have settled down to a vein of contentment or "hatter" life, that was foreign to the men who opened this, and in fact all other mineral locations through Australasia. However, those remaining are scarcely blamable, for the "virgin" bush is impenetrable to all but the sturdy and adventurous, who in the past cut their way without reward and assistance, and opened up country for others to reap the benefit. Good tracks is the desideratum, and these, with Bischoff, Zeehan, Farrell, and Lyell as object lessons, should be put out in all directions.

LIST of Accidents in Inspector Curtain's District for the Year 1906.

Fatal, nil ; non-fatal, 24.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1906.							
10 Jan.	Mt. Lyell M. & R. Co.'s Reduction Works	Queenstown	Fall of window	Wheldon, Barclay	Married	Hand crushed, and loss of finger	Was working as feeder at Smelters. Skylight blew in and fell upon him.
18 Jan.	Ditto	Ditto	Stone rolling from truck	Brown, Stanley	Single	Crushed thumb	Was filling truck at Smelters, when a truck was emptied from above, and a stone rolled down and crushed his thumb, which had to be amputated.
20 Jan.	Ditto	Ditto	Overflow of matte	Casey, Sylvester	Ditto	Neck and shoulders burnt	Was working as leverman at No. 2 converter. In punching the vessel some molten matte flew out.
22 Jan.	Mt. Lyell M. and R. Co.	North Lyell	Derailed truck	Howe, Wm.	Ditto	Crushed finger	Was trucking at North Lyell Mine, when truck left the line and jammed his hand.
1 Mar.	Mt. Lyell Blocks	Ditto	Flying splinter	Menadue, Thos.	Ditto	Loss of one eye	As blacksmith's striker was cutting a rail, when a splinter of metal flew off and injured eye.
22 Mar.	Ditto	Ditto	Fall of timber	Aitchison, Martin Chas.	Married	Bruised back, shoulders, &c.	Assisting in the mine to place a heavy cap in position ; it fell and bruised him.

26 Mar.	Mt. Lyell M. and R. Co.	Mt. Lyell	Flying spall from hammer	Hewitt, Walter	Single	Loss of one eye	Working at the Blow. Lost sight of one eye by a spall from fellow-workman's hammer.
14 April	Mt. Lyell M. & R. Co.'s Reduction Works	Queenstown	Roof falling in	Estcourt, Edward	Ditto	Fractured jaw	Was renewing roof at Reduction Works. He stepped on a sheet of perished iron, fell through, and broke his jaw.
23 April	Ditto	Ditto	Swinging of converter-vessel	Blonquiest, Ellis	Ditto	Leg cut and bruised	Was connecting converter vessel, when its crown swung round and jammed his leg against stand.
16 June	Ditto	Ditto	Fall of flue-dust	Mantick, Charles	Ditto	Face, arms, and feet burnt	Was a labourer at Reduction Works, and cleaning flue, when some heated dust fell upon him and burnt his face, arms, and feet.
27 June	Mt. Lyell Blocks	North Lyell	Fall of clay	Dann, Thos. Wm.	Married	Leg cracked or broken	While having crib in the mine, a piece of the roof fell and broke or cracked bone of leg above ankle.
1 July	Mt. Lyell M. & R. Co.'s Reduction Works	Queenstown	Explosion of white metal	Herrington, Jas.	Ditto	Forehead and eyes injured	While shoeing a rope on the main haulage, the white metal exploded in his face, injuring face, forehead, and eyelids.
15 July	Mt. Lyell M. and R. Co.	Mt. Lyell	Explosion of gelignite	Lydon, Jno.	Single	Eye injured	Put a pick into an old hole at the Blow, when an explosion followed, injuring his eye, &c.
17 July	Mt. Lyell M. & R. Co.'s Reduction Works	Queenstown	Blow from crowbar	Morley, Richard	Married	Fractured jaw	A head furnace-man was removing a water-jacket, when it slipped and struck Morley's crowbar, causing it to fracture his jaw.

LIST of Accidents in Inspector Curtain's District—continued.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1906.							
3 Aug.	Mt. Lyell Blocks	North Lyell	Fall of clay	Stephens, Wm.	Single	Bruised hips and back	Hips and back bruised by a fall of a piece of clay from roof.
28 Aug.	Mt. Lyell M. & R. Co.'s Reduction Works	Queenstown	Breaking of gauge-glass	Ward, Hy.	Married	Eye-ball cut	Working as stoker at converter boilers, when a gauge-glass burst and cut his eye-ball.
6 Sept.	Ditto	Ditto	Fall from platform	Cocks, Arthur Cæsar	Single	General shaking and bruising	Was a tipper on the aerial terminus at the reduction works, and fell from platform into an empty ore-tin, sustaining a general shaking and bruising.
7 Sept.	Mt. Lyell Blocks	North Lyell	Fall through pass	Dingle, Fred. Temple	Ditto	Sprained ankle and bruised knee	Was a stope contractor and fell through an inclined pass by mistake.
11 Sept.	Ditto	Ditto	Walked into pass	Scallan, Thos. Wm.	Ditto	Collar-bone dislocated	Was a general hand, and while walking to his work in intermediate level walked into an open pass.
4 Oct.	Mt. Lyell M. & R. Co.'s Reduction Works	Queenstown	Fall of lamp-board	Walsh, Edgar	Married	Scalp wound	Was a fitter. Was skidding a a lift shaft, when a lamp rest was knocked down, inflicting scalp wounds.
23 Oct.	Mt. Lyell M. & R. Co.'s Lyell-Thursis	Mt. Lyell	Flying spall	Dawson, Benjamin	Ditto	Injury to eye.	Was working in stope, when his eye was injured by a flying spall from his mate's hammer.

22 Nov.	Mt. Lyell Blocks	North Lyell	Fall into pass	Cumming, Jas. Jno.	Married	Bruised elbow and shaken	Was a repairer and fell into a pass, 25 ft., which was obscured by smoke from blasting.
11 Dec.	Mt. Lyell M. and R. Co.	Mt. Lyell	Collapse of rise	Grant, Wm. Fredk.	Single	Broken wrist-bone	Was working at the Iron Blow, when the crust over an old rise collapsed, and he fell with it.
12 Dec.	Ditto	Ditto	Derailed bucket	Phillips, Robert	Married	Cuts and bruises to back and neck	Was filling aerial buckets, when one toppled over him and inflicted cuts and bruises.

REPORT ON THE MATHINNA GOLD FIELD.

PART I.

[With Eight Plans.]

Government Geologist's Office,
Launceston, 29th March, 1906.

SIR,

IN accordance with your instructions, I proceeded to Mathinna on the 7th August last year, and remained on the field till the 17th of that month. Later in the year I visited the district, from 13th October to the 10th November, and again from the 7th to the 22nd December.

No departmental report on this field has been issued since 1892, and the work done since then on some of the large mines necessitated prolonged examination. Even now it has not been possible to finish inspection of the whole field. Consequently, it has been thought advisable to issue this part of my report as a first instalment, in preference to waiting for the completion of the whole.

Mathinna (the native equivalent for its original name of Black Boy) is a neat-looking township of some 800 inhabitants, situate 17 miles north of Fingal, at the base of the spurs descending from the Tower Hill range. Continuous aneroid readings in connection with simultaneous observations at the Victoria Museum, Launceston, gave for Mathinna a height of 1024 feet above sea-level. This figure probably approximates the truth as nearly as is possible with an aneroid, which, as is well known, cannot be relied upon for absolute readings. There is no use in giving aneroid readings a fictitious appearance of accuracy, and hence, for the purposes of this report, the height of the township above sea-level will be taken as 1000 feet.

The road to Mathinna from Fingal runs along the alluvial flat bordering the South Esk, in which gravels, carrying more or less gold at different places, have been deposited. These flats are part of the Malahide estate, extending nearly all the way from Fingal to Mathinna. At Mathinna they are joined by the deltas of the Long Gully and the Black Horse Gully, which are ravines or valleys scooped out on each side of the Gate spur or ridge.

The parallel of Fingal (250 feet below Mathinna) forms the southerly termination of the auriferous slate series, if we except the patches of slate between Bicheno and the

Schoutens. This slate and sandstone series, the carrier of innumerable gold-bearing quartz reefs, extends northwards without a break through Mathinna to Mt. Victoria, and is bounded on the west by Ben Lomond and on the east by the Tasman Sea. It is the basement rock below the drift of the valleys, and rises to the tops of the lower hill ranges, but towards the summits of the high mountains is overlaid by grits, sandstones, and shales of Permo-Carboniferous and Mesozoic age. Through these has protruded the eruptive diabase, which, in columnar form, builds the peaks of the dominant mountains of this area. The South Esk River takes its rise some distance west of Mathinna, and describing an immense sweep to the south runs a course of 140 miles before it empties its waters into the Tamar, at the Cataract Gorge, Launceston. The gravel of the Cataract Gorge carries a little gold, which has been carried there all the way from Mangana or Mathinna. The distance forbids any anticipation that payable quantities are to be found in the Gorge, which, moreover, is of too recent an origin for that, even if the distance had been less.

The auriferous series at Mathinna is assumed to be of Ordovician (or Lower Silurian) age, partly from its analogies with Victorian strata, partly because while elsewhere in Tasmania Upper or Middle Silurian beds are fossiliferous, this series has so far yielded no fossil remains. It is strange that no graptolites have yet been discovered. I looked over the surfaces of the tips at most of the Mathinna mines, but could find no signs of fossils, nor could I hear that any discovery had ever been made. Some of the difficulty in finding any is perhaps due to fossil impressions occurring mostly on the bedding-surfaces, whereas most of the fragments of slate on the mine heaps are cleavage-flakes. There is no real schist in the series, though some of the varieties of slate have improperly been called by that name. The rocks comprise clay slate, graphitic slate, arenaceous or sandy slate, sandstone, quartzite, argillaceous sandstone, and frequently of a mixed character, partaking of the characters of both slate and sandstone.

It is only occasionally that any difference can be detected between the bedding-planes and cleavage-planes. It is seen, however, in the upper tunnel at the Eldorado (now Ophir), where the former dip easterly at about 45°, and the latter westerly at a very steep angle. The latter strike throughout the field between N. 25° and N. 30° W., underlaying to the east of the Golden Gate shaft, to the

east, and west of the shaft to the west. I attempted, during my stay in the district, to trace the directions of strike and underlay from one mine to another, hoping to be able to deduce some rule which might be useful in forming an idea of the lines along which mineral may be sought. I cannot say that I have evolved any complete theory, but some of the observations are, to say the least, suggestive.

The field must not be considered by itself, but must be regarded as part of a mineral belt extending from Mangana to Mt. Victoria, and even further north. The mean direction of the lamination-planes is approximately the same all through the belt (and these are probably cleavage-planes), and the bearing which this has upon reef-formation is apparent when we consider that in all probability the direction of the main reef is dependent upon the strike of these planes. Compressive lateral force produced the planes of separation, and thus formed channels for the passage of silica, which, relieved from superincumbent pressure by the secular folding and splitting of the strata, welled upwards into the beds along the linear directions created for it. There is a good deal of white mica (muscovite, sericite) in some varieties of the slate, and most of this mineral is probably not original, but the product of dynamic metamorphism. Some of it, on the other hand, may be derived from the waste of older granite, as must have been the fragments of felspar which occur (in microscopic size) in the more sandy slates met with in some of the mines. The granite of which the mineral formed a part was obviously of much greater age than any of the known granites on the East Coast, which are approximately Devonian: and we can form no more than a very shadowy idea of where those ancient granite ranges can have been—certainly distant, for the Mathinna sediments were deposited in a comparatively, though not very, deep sea.

The main fractures on the Gate line at Mathinna strike north, or a little to the east or west of it, and these are naturally accompanied by others coursing south-east and north-west, in accordance with the laws of strains, but the former are the more important, and continue for long distances, not perhaps in uninterrupted courses, but overlapping each other. In the New Golden Gate Mine it seems to be a rule that when the reef is gold-bearing, its course is east of north, and when west of north it is barren. There must be a reason for this, and possibly it is that more resistance was met with in breaking through the strata in a north-easterly direction, and consequently

the conditions were more favourable to precipitation from a solution: while a north-westerly direction was nearer to the strike of the laminations, and the flow of silica would be less checked.

The axis of an anticlinal runs through the Tasmanian Consols shaft, and close to it at the 1000-feet and 1100-feet levels, and is also observable in the New Golden Gate Mine, from the 1100-feet level downwards, called saddle or horse country in the latter mine, the new make of quartz descending upon it and falling away into separate reefs east and west. In the Consols I was fortunate enough to see the central arching of the anticline. The centre does not show regular folding, but an abrupt junction, pointing to rupture. The Gate and Consols line of lode is closely connected with this anticline. On the east side of Long Gully the strata underlie easterly, on the western side they underlie westerly. The dominant underlay in the Gate ridge is westerly, and the laminations right across the Black Horse Gully and in the hills to the west of it have a continuous dip to the west. We have, therefore, in the Long Gully, an important anticlinal axis and an important lode-line, and it is difficult to believe that the two are not related, even if the course of each is not actually identical.

The strata exposed in the side of the new road below the Gold Estates shaft and Cemetery underlie westerly, and this dip continues southwards to the New Golden Gate, where it can be observed in the surface excavations west of the mine; thence to the Volunteer Consolidated Extended section the dip is westerly. The apex of the arch south of the South Gate shaft seems to be on the crest of the ridge, where vertical laminations are seen in the race. Following the Long Gully southwards the easterly dip prevails at the South Miner's Dream, Telegraph tunnel, and Mountaineer. The Derby shaft of the Jubilee Mine is apparently on the axial line of the fold, for east of the shaft the strata dip to the north-east, while on the southern side of the creek and at the Mountaineer they underlie south-westerly. We have therefore an axial line persisting from Mathinna to the Jubilee having a strike of S. 20°-25° E., along or parallel to which a system of gold-quartz reefs is developed. This system has been traced as far north as the Golden Stairs sections, and continues into the reefing country on the north side of the Esk, beyond which indications of a similar stratigraphical fold, accompanied by numerous reefs, have been observed at intervals on the line of the

Dan and Dorset valleys, as far as Alberton. We are in the presence here of a geological fact which clears up a good deal of what was otherwise vague and uncertain, and which compels the belief that the various reef occurrences in the Mathinna field are not sporadic, or exceptional and casual, but are part of the results of an orderly and comprehensive, even vast, process which has involved the whole line of country from Tower Hill to Mt. Victoria. The recognition of this lends strong encouragement to continued work in this field, for such a far-reaching process must have produced deep-seated effects, and in my own mind I feel sure, viewing the question quite apart from the chances of mining in any particular spot, and in the dry light of geological science, that the deposits of gold which have already been worked have neither exhausted the possibilities of the field nor furnished any adequate idea of the sources of gold which yet await discovery.

The longest distances of reef actually followed are, perhaps, the east reef of the New Golden Gate and the west reef of that mine and the Tasmanian Consols. The respective distances are as follows:—On east reef, 511 feet; on west reef, 1020 feet.

But individual reefs need not be expected to be strictly continuous for extreme distances. It will be found that they come to an end at intervals, and parallel ones come in, either totally distinct or connected only by stringers of quartz. This indicates extensive fracturing of the country, and is now looked upon as more favourable for ore deposits than single fissure channels. This is a repeated phenomenon in the Mathinna field. Hence, the reefs which are found in distant properties along the line are not continuations of the others, but still are results of the same fracturing and filling processes. Thus slight variations in course are of no value in determining identity or otherwise of the various reefs, for the bearing of two overlapping reefs may be identical. These "splices" are of quite common occurrence, and explain how it is that the various reefs may vary in direction while the reef-zone or belt of strata within which they occur maintains a uniform strength for a long stretch of country. It can be understood, accordingly, how unsafe it is to stand on an outcrop and conclude that it is an actual continuation of a reef on the same course some distance away.

The general experience of the field is that the surface-rock, and down to a depth varying from 50 to 150 or 200 feet, is unsettled. Down to 50 or 70 feet it is weathered and broken, as a rule, though in some parts of the field

the unoxidised blue slate is met with sooner. In the New Golden Gate Mine the blue slate does not appear until the 116-feet level is reached. This broken nature of the ground near the surface, accompanied by numerous irregular vein-channels of no great importance in themselves, is only what has been observed in mining fields nearly everywhere, and has been explained by supposing superficial cracks and fractures to have been filled with silica brought by atmospheric water descending from the surface. Many of the crevices at the surface are believed to be due to shrinkage, arising from decomposition changes in the rock itself, and not to fractures connected with any reef system. At the same time, reefs which are strong and solid in depth show their channels right through to surface in a degenerate form, and often quite blank. Thus, in the surface adit of the New Golden Gate Mine, the track of the main reef at 20 feet from surface appears only as a line of pug, so that no wonder it was passed over at the time: and Loane's reef merely showed as a soft band a few inches wide, with a little quartz in the sole of the drive, where Mr. Loane sank upon it. The superficial rock of the district has been everyhere affected by atmospheric agencies, oxidised, often carbonated, hydrated, swollen, broken up in places, and its position changed by the action of gravity after cracking, so that surface observations of underlie and bearing of the strata are often contradictory and unreliable. A good deal of this superficial disturbance is noticeable on the crest of the Gate ridge, where blocks of twisted slate are exposed with their laminæ bearing in different directions. An instance of how the simple weight of overburden may alter the underlie of strata locally occurs in the approach to the tunnel of the Victorian Golden Gate Mine, where the slates are flexed and broken by the mere swelling and weight of surface-soil.

It does not seem likely that the broken veins and quartzless reef-channels noticed so frequently at shallow depths were ever large, solid reefs comparable with some of those which have been met with at deep levels. I distrust the opinion which considers them as the superficial fragmentary remains of large and important reefs. Similar attenuations and disappearance of quartz from the reef-channel may take place at great depths, and *per contra*, huge reefs of barren quartz may occur cropping out at the surface itself. The most reasonable conclusion appears to be that an unfavourable condition of reef near the surface betokens simply weak parts in it, which may and do occur everywhere, both at upper and lower levels,

and are the more affected and altered when they happen to be within the zone of weathering. The experience of the New Golden Gate and Tasmanian Consols Mines shows that poor reef indications at surface may be replaced in depth by splendid bodies of stone. So long as there is a channel with signs of lode action at or near the surface, there is also the possibility of solid stone in depth. Mining companies should ever keep this consideration in mind.

If we seek to class these reefs among the types met with in different parts of the world, we must rank them in Dr. R. Beck's division of pyritic gold-quartz reefs, *i.e.*, reefs of gold-bearing quartz with dominant iron pyrites. An increase of arsenopyrite leads to another type laid down by Beck, viz., arsenical gold-quartz reefs. Varying proportions of each pyrite connect the two types. Following Dunn and Courtis, I have sought by microscopical examinations of the fluid cavities in the quartz for some distinctly recognisable relation between structure and gold contents, but unsuccessfully. The presence of the associated minerals still remains the most favourable indication, though even this is not an infallible one.

In the neighbourhood are no basic or neutral eruptive rocks which could have any sort of connection with these reefs.. The diabase, which crowns the summits of the adjacent high mountains (Tower Hill, Huntsman's Cap, Mt. Saddleback, Mts. Albert and Victoria) is of Mesozoic age, and long subsequent in date to the auriferous reefs. To the north-east of Mathinna, on a meridian 10 miles to the east, the granite region begins. It is there traversed by gold-bearing quartz reefs, which also enter the adjoining sandstones; and we must refer the Mathinna reefs in all likelihood to siliceous fluid expelled from the underlying granite magma in the last stage of its consolidation.

As for the source of the gold, it must be borne in mind that reefs in the granite carry gold also, which cannot possibly have been derived from any sedimentary country-rock. Any theory of origin must cover the case of the reef both in granite and stratified rocks. It would be unreasonable to contend that while the gold in the granite reefs was derived from the igneous magma, when the reef entered sandstone the igneous gold by some incomprehensible means became exhausted, and the reef began to collect gold from sea-borne sediments.

The few observations which I have been able to make in various parts of this State would tend to support the supposition that the origin of our gold-quartz is mainly

granitic, and that the formation of the reef is essentially connected with tectonic disturbance of the stratified rocks.

Facts connected with the mode of occurrence of the gold may be discussed with advantage.

The minerals associated with the noble metal in the reefs are pyrite, arsenopyrite, chalcopyrite, galena, and zinc-blende. We know that all these sulphides are precipitants of gold. In Prof. Liveridge's experiments* their value in this respect was in the following order:—1. Iron pyrites. 2. Copper pyrites. 3. Arsenical pyrites. 4. Galena. 5. Zinc-blende. These have been proved to precipitate gold from solution in the laboratory, and the probability is that they have precipitated the gold found in the reef-channels. Van Hise† says:—"The gold is thrown down from its salts by the baser sulphides, not as a sulphide, but as metallic gold, because gold and sulphur have such weak affinity, and gold is so easily reduced to the metallic form."

The reefs in the Gate belt carry in their payable portions from 1 to 1½ per cent. of sulphides, containing from 5 to 10 dwts. gold per ton. For a long time the New Golden Gate sulphides which were contained in 1-ounce stone yielded 10 ounces gold per ton, and quite recently some pyrites from the 1600-feet level yielded 80 ozs. gold per ton.

Galena and blende are universally regarded on the field as good indications for gold; and colours of gold may sometimes be seen in hand-specimens close to those minerals, as well as to copper pyrites. The mottled and looser-textured quartz is considered more favourable for the occurrence of gold than is the white, tight, glassy variety, though on the other hand gold is sometimes seen in the most unkindly-looking stone. In the upper parts of the New Golden Gate reef the sulphides, when present, are distributed indifferently all over the stone, but in the lower levels they are apt to occur in bands, separated by bands of white quartz with scarcely a speck of pyrites. In the lower levels of this mine there is a noteworthy absence of the zinc-blende, which was one of the sulphides in the upper levels.

In some parts of the Mathinna field high returns have been obtained from small quantities of stone at shallow levels, notably at the Miner's Dream Mine, where yields are recorded of from 3 to 11 ozs. gold per ton. Some of the quartz from the City of Hobart adit is recorded as

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*Journ. Roy. Soc., N.S.W., 1893, p. 329.

† A Treatise on Metamorphism, by C. R. Van Hise, 1904, p. 1171.

averaging quite 2 ounces to the ton of stone; and there are other instances. The Eldorado in the old days had some crushings which returned from 2 to 3 ozs. gold per ton. These rich surface and shallow yields are the general experience in gold-mining everywhere, and from careful examination of innumerable specimens from mines in this State I feel almost certain that there has been an enrichment by re-precipitation in the zone of weathering. On this theory, once this zone has been passed through, although the stone will be poorer, there is no reason for anticipating any progressive impoverishment as long as a shoot lasts. The New Golden Gate stone has been remarkably uniform in quality down to the lower limits of the shoots in the reefs. The falling off which appears in the published accounts is only apparent, as the returns include quantities of stone which were probably outside the shoot, and this has reduced the average for many months past to 8 dwts. per ton. The gold-bearing shoot at the Tasmanian Consols is even better at the 1300 and 1400-feet levels than it has been anywhere at a higher level. Re-precipitation in the zone of weathering tends to explain the greater purity of the gold near the surface, as compared with that at greater depths. It has apparently been disassociated from its accompanying silver, and the proportion of the latter metal is accordingly relatively greater in depth at any particular mine. Figures, which Mr. H. J. Wise kindly furnished me with in 1904, in reference to this question are highly interesting. They represent the average fineness of the battery-gold won from the New Golden Gate Mine between 1890 and 1903, and are as follows: —

Year.	*Gold.*	*Silver.*
1890	·9035	·080
1891	·9125	·073
1892	·9055	·084
1893	·9096	·080
1894	·9022	·087
1895	·9084	·079
1896	·9057	·082
1897	·9031	·087
1898	·8978	·089
1899	·8922	·092
1900	·8843	·100
1901	·8812	·100
1902	·8849	·098
1903	·8834	·099

The above shows that on the whole the gold was more free from silver in the upper levels. A similar result appears on examination of returns from another deep gold mine in our State. Mr. W. Radford was good enough to favour me with some figures compiled by Mr. J. T. Stubs, General Manager of the New Pinafore Mine, at Lefroy. These have been compiled from mint reports, extending over a period of fourteen years, and refer to battery-gold won from the New Pinafore reef.

Alluvial gold from the 200-feet level:—

Gold.	*Silver.*
·9535	·035

From surface to the 360-feet level:—

Gold.	*Silver.*
·9450	·045
·9550	·035
·9492	·040
·9005	·065
·9550	·040
·9375	·055
·9492	·040
·9175	·075

From 1100-feet and 1200-feet levels:—

Gold.	*Silver.*
·9040	·075
·9015	·070
·9255	·060
·8500	·055

These results are in accord with those obtained at Mathinna, and Dr. J. R. Don has established similar differences between shallow and deep gold in Victoria and New Zealand.*

Discontinuous quartz-veins, which are frequently seen to close up and disappear, when followed down by shallow pits ("Native Cat reef"), are common on the hill range west of Black Horse Gully. These veins affect sandy zones of the general slate country, and have silicified the rock immediately adjacent, sometimes only for a few inches on each side, sometimes for a foot or two. The silicified

* The Genesis of certain Auriferous Lodes, 1897, pp. 44-46.

wall-rock follows the vein, and thus the appearance is occasionally produced of a band of sandstone crossing the country-rock at an angle to the direction of the general laminæ. There is no reason to suppose that the lode-channel really terminates where these veins disappear. Where they occur, they are usually numerous, and indicate a rather extensive zone of fracturing, which, if followed down to substantial depths, would in all probability give way to a zone with fewer fractures and more important reefs. It is in the highest degree improbable that they are independent vein-systems. Cracks and fissures in the rock will be found to connect them with the larger reefs in depth. Though they are often too narrow to be payable, they may be regarded as valuable indicators of more persistent channels below. It is matter of general observation that earth fractures, produced by regional strain, are most numerous near the surface, and most erratic; while they are fewer and more regular at a greater depth. The disappearance of these irregular veins may consequently often bring the operations of small working parties to a standstill, but should not discourage companies with capital from sinking to the lower zone.

Although folding of the rocks has been intense at Mathinna, and arches are formed here and there, the auriferous quartz-bodies do not appear to prevail in the apices and troughs of the country as in saddle reef. At the same time, the rock folding and rupturing have produced channels which have determined the deposition of the vein-silica. Examples exist of fractures due to compressive stress as well as to tension. These fractures or lode-channels have generally been subjected to a little movement after formation, producing a more or less smooth wall on one side, while on the other, more often than not, a ragged edge exists, caused by the silica wandering into the adjoining country.

From the New Golden Gate northwards the fracture or reefing-zone is indicated by the workings at the Tasmanian Consols, the reef under the Catholic church on the hill, the old works at the Spur Mine at the back of J. Polley's, and the reefs on the Golden Stairs in the extreme north. Going south from the New Golden Gate this zone is crossed by the main and second slides in the Gate levels, which represent fractures or breaks in the country, persistent from level to level. The main slide has been traced down to the 1400-feet level. Below that the workings have not advanced sufficiently to meet with it. As will be explained

later on in this report, there seem to be grounds for believing that these slides are not dislocators of the reef, but simply supplied channels for its deviation. They have certainly produced either a downthrow or upthrow of the country, but their direction is that of the slates, and the latter continues unchanged south of the fault. The reefing-zone also continues south through the South Gate, Miner's Dream, Telegraph tunnel hill, old City, Jubilee, and Mountaineer. This is a distance of 2½ miles in a direct line north-westerly and south-easterly. Further south not much has been done until the Sunbeam and Twilight old mines are reached, nearly half-way to Mangana.

Parallel reef-zones exist both to the east and west. On this visit I examined that to the immediate west, leaving the eastern line for my next journey. The central or Gate zone is perhaps 10 to 15 chains wide. The western zone is about double that width, and the reef-systems are more varied. On the Eldorado and Gladstone hills most of the reefs strike a little to the north of west, and on the City of Hobart the dominant strike is north and south, accompanied by subordinate fractures east and west. The Black Horse Gully separates this western zone from the Gate line. The gully does not denote any divisional line of faulting; still, the crosscuts from the Gate and South Gate mines tend to show that a barren strip of country separates the two zones. In addition, the strata on the two hills differ somewhat in nature, those on the Eldorado side being more sandy.

The Eldorado and Gladstone hills abound with gold-bearing reefs, running mostly in north-westerly or westerly parallels, none of which have been worked at more than shallow depths. The general strike of the strata is N. 25° to 30° W., and the underlie south-westerly. This dip prevails through the hill, though there are some minor folds. Minor faults also exist in this tract, displacing the lodes here and there. A little further west on the City of Hobart and Martyn's line, the reef channels assume again a north and south direction for the most part, though the strike and dip of the strata remain unchanged. Strictly speaking, this line of country passing through the City of Hobart ground should be regarded as a parallel zone, distinct perhaps from the Eldorado zone of east and west reefs, though geologically the two are one. The City of Hobart main shaft was sunk to 660 feet, and the reef worked at 500 feet A good many shafts of less depth

have been sunk on this property; but the above is the deepest reached on this zone. Mr. Martyn's shafts further south are down 60 and 72 feet from surface on a north and south reef. Outside these workings this reef-zone has not been explored; and its prolongation both north and south requires examination.

New Golden Gate Mine.

Sections 13-87G, 320-87G, 185-87G, 295-87G, 261-87G, 81-87G, 1441-93G.

The New Golden Gate Mining Company has been working its mine since 1888, during which time it has raised 267,140 tons of quartz, and produced 222,755 ozs. of gold, an average of 16 dwts. 16 grs. per ton of quartz, and realising £847,075 7s. 4d. Its share capital is £9600, in 32,000 shares of 6s. per share. The total amount which this famous mine has paid in dividends is £355,200, or £11 2s. per share.

The main shaft has been sunk to a depth of 1620 feet, and the reef opened upon at 17 levels, from 116 feet to 1600 feet from the surface. This is consequently the deepest mine in the State. It is what may be called a dry mine, and well ventilated, and the work and appointments throughout are creditable to both company and manager. Owing to the increasing depth and a little increase in the water, an electric pumping plant has been installed recently, and is giving high satisfaction.

The principal features of the mine are, (1) the two powerful gold-bearing quartz reefs, Loane's reef and main reef, going down from the surface adit to the 800-feet level (Loane's to the 900-feet); (2) the new make or east reef, beginning over the 800-feet level and descending to the 1600-feet; (3) the west reef (Nos. 1 and 2), about 60 feet west of the shaft, descending from about the level of the 1300-feet to the 1600-feet. This may be the same as the western reef intersected in the surface adit, but as nearly 1200 vertical feet of unproved ground exists between them, their identity is a matter of conjecture. It is probable that they are different reefs.

In the surface adit an ill-defined formation was passed through between Loane's and the western reefs, known as the central reef, but this has not been seen lower down. It most likely junctions with the western reef in depth.

Loane's reef is the only one which goes up to the surface. Mr. A. Loane, prospecting in the adit driven by the

old company, sank a winze on the reef-channel which had been intersected, and which showed a little quartz. A few tons of quartz were got out, yielding between 1 and 1½ oz. gold per ton, and the present company was formed in 1887. Mr. Thos. Andrews, the present manager, took charge of the mine, and insisted on sinking a main shaft, which was at once started. The oxidised soft rock persisted to about 100 feet from surface, and was then succeeded by the unaltered blue slate of the deeper zone. At that depth a new parallel reef was cut through in the shaft, which received the name of the main reef, and which has since been followed down parallel with Loane's to a depth of 800 feet, and distant from the latter 10 to 30 feet. This important reef is not recognisable in the surface adit. A line of "dig" in the adit walls may possibly represent it, but an effort of the imagination is required to connect the two.

Above the 116-feet level neither of these reefs proved valuable; at most, only little short shoots occurred in the reef-channels. At the 176-feet or No. 2 level they were still very poor, but at 236-feet or No. 3 level the gold started to make in both reefs. At this level, Loane's reef strengthened to a width of 9 feet, and yielded quartz worth 2 ounces gold per ton. North of the shaft these reefs run parallel, but south they converge and finally junction, forming a fine body of gold-bearing stone where this takes place, attaining a width of as much as half a chain. As deep as 800 feet, Loane's reef when cut was over 28 feet of clean payable quartz, the average being perhaps 6 to 8 feet at the different levels. The average of gold contents of the stone won from the two reefs has been about 18 dwts. gold per ton. The underlay of both reefs is to the east, and its mean amount is 1 in 8; at the 800-feet level they are vertical. Loane's reef continued to yield gold down to the 900-feet level, and then dwindled to a track; the main reef also giving out at the 800-feet. In 1896 a new reef (east reef) from 4 to 13 feet wide, was struck at the 900-feet level. This was followed up to the 800-feet level, and has been worked in the lower levels, attaining a width of 22 feet of stone. From 800 to 1100 feet it descends vertically, about 50 feet west of Loane's reef, but thence to 1500 feet underlies east at 1 in 2. At 1600 feet the reef is again vertical, or underlying very slightly to the east. Large quantities of stone have been crushed from this reef down to the 1300-feet level, but below this the quartz has been poor, though undiminished in size.

The western reef has been driven on at the 1300, 1400, 1500, and 1600-feet levels. It may be regarded as a western leg of the new make, the eastern leg of which formed the east reef. Its underlay is to the west. Between the two reefs is the horse or centre country of the great axial fold mentioned earlier in this report. The western reef is a strong and persistent channel, varying from 4 to 15 feet wide, returning variable stone, some of it very good, but on the whole not realising expectations. It continues north into the Tasmanian Consols Mine.

The exact position of affairs underground may be best understood by considering some of the levels separately, and the following descriptive notes will assist in this. The upper levels were dealt with in Mr. A. Montgomery's report of the 12th September, 1892, since when the mine has been developed to a much greater depth, and the problem has become an entirely different one.

500-*feet Level.*—The crosscut from shaft has been driven 350 feet west, and intersected reefs which are assumed to be the central and western ones, which were seen above the 176-feet level and in the surface adit, but which here are of no value. East of the shaft the Main and Loane's reefs have been worked with advantage. West of the shaft is the perplexing slide country.

At 190 feet west of the shaft a slide traverses the crosscut. It is here a break in the country 4 or 5 inches wide, bearing S. 30° E., and dipping south-westerly at an angle of 3 in 7. A level has been driven along it in a south-easterly direction, and at 125 feet in, a strong reef was driven across, with 25 feet width of solid quartz. This was followed south for 70 feet, when a fault occurred, bringing the quartz round to the north-west, in which direction it was followed through three more subordinate faults. The reef is thus cut up into separate segments by these four breaks, each successive segment being removed further west and north. No. 1 segment was the large block south of the first slide, and appears to be cut clean off at the south end of the stope, the smooth slickensided wall of the fracture denoting movement. It is noteworthy that some of the quartz passes through the slide without deflection, and then dies out. Between this and the next slide a segment of reef striped with quartz has been to all appearance heaved north, a phenomenon repeated a little distance further north by a further slide. The quartz veins in these three blocks of stone are in parallel lines, but the stone between the two following slides is more

mixed with country, and the direction of the veins is not so evident.

The features of this occurrence are peculiar. The smaller segments of quartz are only partly divided by smooth faces or breaks, *i.e.*, the latter do not extend fully across the stope. In the fourth segment the quartz veins are not at right angles to its course as in the others, but in strings parallel to the walls of the fault; and the last slide does not appear to be so clearly cut as the others.

The long level further west is along the course of a long slide, only 50 feet south of this line of breaks; consequently, if we could replace the faulted segments in what seems at first glance their original position, they would form a reef crossing that level. But there is no sign of a break in the level-walls which would indicate the passage of any reef. How then account for the present positions of the reef segments? It must be confessed that this is difficult, and more requires to be known before a definite conclusion can be drawn. A possible explanation is that the quartz between the two main slides was deposited there in broken country subsequent to or simultaneously with the formation of the main slide-channels, following, perhaps, a somewhat tortuous course, and that the broken country-zone has afterwards been subjected to minor secondary faulting which has displaced blocks of country and reef.

At 348 feet west of shaft the crosscut enters the level driven along the long slide north-westerly for 200 feet and south-easterly for 500 feet. Towards the end of the north-western drive, 47 feet behind the face, a turn was taken due west, with a view of getting outside the broken country. At 30 feet from the end a slide consisting of one or two inches of white clay crosses the level north-westerly and south-easterly, and close to it is a band of intensely-folded slate. The level is apparently not yet beyond the disturbed zone. The south-east (or, as it is called, the south) drive from the crosscut follows a kind of soft slide running with the country between good slate walls. As the drive proceeds the slates become twisted, and carry eyes and lenticles of quartz; evidently a disturbed belt. For the last 260 feet the drive continues due south. Broken bars and arches of quartz here and there show the continuance of somewhat unsettled country.

At 108 feet behind the end crosscuts have been driven east and west on a reef formation. In the west crosscut, driven 38 feet, this consists of parallel quartz veins and

black slate 1 foot to 2½ feet wide, and the same formation has been followed for 64 feet in the east crosscut, carrying little lumps and veins of clean white quartz. In the face it has a twisted appearance, and does not look kindly.

The line of clay crossing the north drive towards its end is supposed to be the second main slide.

At 30 feet behind the end of the south drive an exploratory crosscut east is now being driven. At 290 feet it has entered a reef channel, which is being driven across. It has been fairly well established by west crosscuts in the Gate and South Gate mines that the country to the west of the disturbed zone is reefless for a good distance, while formations are known to the east (at the South Gate). This exploratory crosscut must be considered as a good piece of work.

1200-*feet Level.*—The deeper levels of the mine, where driven far enough, show features common to all, for from the surface downwards in each successive level going south a main slide appears to cut off the reefs. Its average bearing is N. 35° W.—S. 35° E., and its hade is 3 in 7 to the south-west; consequently, it interferes with the reef further south in each level as the mine gets deeper. This occurs with such unvarying uniformity at each level as to enable a pretty accurate forecast to be made of the behaviour of the reef at the level below. Strenuous efforts have been made to recover the reef beyond the slide, but so far its southern extension has not been found. The occurrence in the 1200-feet level is so typical that it may be discussed in detail.

The arched reef formation occurs at and near the shaft, dipping westerly in one direction and easterly further in the crosscut. The crosscut before reaching the east reef takes a bend easterly in hard slaty sandstone. It cuts the east reef and passes through it for over 12 feet. The reef was here found to be poor. The level was continued on the reef south nearly 500 feet, the last 170 feet being reported as 12 feet wide of clean stone, assaying 17 dwts. per ton. The shoot of gold-bearing payable stone in this level has a length from north to south of between 200 and 250 feet, and at its southern end is traversed by the main slide. Just north of the slide was very good stone—17 to 18 dwts.; but the quality fell off to half that value after passing through the fault. At the slide the reef bends round to a right angle with its previous direction, and follows the fault-line north-westerly, eventually dying out. This has always been called the "drag" of the reef, being

similar to what is frequently seen in the fault-channel of a dislocated reef. As, however, the strike of the country is practically unaffected by the slide, it is highly probable that the great bend in the reef is a deviation along the pre-existing slide-channel rather than a reef-faulting. If the reef has really been faulted, the faulted part ought to be recovered to the west, which has not been done, in spite of a long crosscut in that direction. The conclusion which I arrived at on examination of this occurrence was that the reef itself had not been faulted. It seems possible that the fracture of the country and the deposition of silica in it were practically simultaneous. The consequences of such a conclusion are far-reaching, for if it be true, search for a faulted portion of the reef would be unnecessary, and all that could be done would be to follow the deviation; which, in fact, has also been done for 200 feet north-westerly.

The level has been extended beyond the slide due south for 270 feet. At 200 feet it passes through a second slide, striking north-westerly and south-easterly, and dipping south-westerly. A few inches of slate and quartz are met with. The country between these two slides is disturbed, showing twisted and curved slates, but preserving the same general strike as that back north. Immediately south of the second slide the country is deflected to a due south strike, but recovers its normal bearing within a few yards. It is usually a grey slate with small bands of a darker graphitic slate, which continues to the end of the level.

At the end of the level a crosscut due west has been driven 260 feet, to explore the country in that direction and pick up any faulted part of the reef. The country passed through is mostly hard grey slate, with two hard quartz-veined bands of blocky stone, emitting some water. One of these water-channels marks an anticline. This crosscut is now suspended. The position of the end is 90 feet from the western boundary of the 3-acre section, and 180 feet from the southern boundary of same. This crosscut has carried out the useful work of testing the ground south of the slide in a western direction, and has proved the non-existence of a faulted reef within any reasonable distance. If the reef has been faulted at all, it has been heaved an extreme distance into O'Kelly's section on the western side of Black Horse Gully. Works on that section or in the Eldorado ground would have an off-chance of meeting with it. But, as said above, I doubt whether there has been any heave. It is more likely that a reef-

zone continues indefinitely to the south, within which crosscuts at intervals would disclose discontinuous reefs all along the north and south line. Within the limits of the zone, *i.e.*, within a short distance of the main anticlinal axis, reefs and makes of quartz undoubtedly exist, and if the Gate reef has for a time lost itself, as it were, in the slide-channel, there is every likelihood of it being succeeded further south by fresh splices and stretches of reef.

In the 1200-feet level, at 180 feet north of the slide, a crosscut east has been recently started, and at 190 feet east of the level is passing through a wide reef channel carrying bands of quartz from 6 inches to a foot wide. At the time of my visit a width of 20 feet of this formation had been cut into. The primary object of the crosscut is to cut a west leg dropping from the main reef; a further aim is to prove the country east of the Gate reefs, which is known to be in the reefing line.

1300-*feet Level: East Reef.*—The reef was struck in this level in 1899, where it showed 4 feet of gold-bearing stone. The same lode-channel of hard country and veins of quartz as met with above was passed through in the crosscut from shaft. The reef rapidly improved when driven on south to 6 feet of payable stone. At about 100 feet from crosscut it began to widen considerably, and soon reached a width of 16 feet, but of moderate value, viz., 3 to 8, or sometimes 9, dwts. per ton. The value is said to have varied a good deal. Near the slide the reef formed a large body of clean stone, 15 feet wide and of variable quality; a rise put up proved a block of highly-payable quartz.

After driving 550 feet from crosscut the first main slide crossed the reef, bearing S. 27° E., and dipping south-westerly. A curious report exists on the mine that the slide still moves. Once a sound like a dynamite explosion was heard, and all the men left their places, but all that ground has been stoped since and nothing was ever seen. No doubt tension still exists in the strata, and is relieved by rupture now and then. The same thing has been noticed in other mines in the State. The ground has been stoped on the north side of the fault, but only a track, as it were, passes through to the south. At about 60 feet south of the fault the stone made again in a large shoot, at first barren, and further on carrying a few dwts. gold to the ton, but there is no stope south of the slide. The end of the drive south of the slide is now filled in, but I am told that it was extended through the second slide with a little stone, which died out.

The east reef, where struck by the crosscut from shaft in this level, is striking north and south, and is within 20 feet of the eastern boundary of Section 13-87G. Further south it bears to the west of south as much as from 10 to 20 degrees.

West Reef.—220 feet west of the east reef at the 1300-feet level the crosscut intersected the No. 1 west reef, as the main western reef is called. It is here small and poor, and the walls converge downwards, but the winze 10 feet to the north shows that it descends vertically to the level below. It only shows leaders of quartz in a 7-feet channel here, and carries no gold. It has been driven upon north 260 feet, or within 65 feet of the Consols boundary. The winze at the end of the drive goes down to the level below, and proves that the channel is identical with the one at the 1400-feet. Half-way in the drive is a blow of stone, which, however, is practically barren.

Twenty feet further west what is called No. 2 west reef has been reached by the crosscut, but the appearance of this wherever it has been cut in the mine tends to show that it is part of No. 1 west.

1400-*feet Level.*—At this level a long crosscut from shaft traverses north and south the whole width of Section 13-87, *i.e.*, to within 15 feet of the west boundary, and 20 feet outside the east boundary. At the latter point the east reef was met with, and has been driven on 33 feet north and south, to within 150 feet of the slide. Where it was intersected, it was 26 feet wide, white quartz, hard and poor. For the full distance driven the reef is well defined and clean, but the assays did not show more than 1 to 3 dwts. gold. The gold-bearing shoot at this level is apparently still ahead of the end, and will be shorter here than in the level above. This shortening of the shoot suggests its pinching out in depth, if nothing exists parallel with the level, and suggests search at deep levels for splices or parallel shoots rather than for a continuation of the present shoot downwards. On the other hand, some continuation downward along the slide-plane is probable.

West Reef.—At 112 feet west from the shaft the crosscut at this level intersects No. 1 west reef, and at 33 feet further No. 2 west reef.

This was a new discovery at the time. No. 1 reef has been driven on south for 440 feet to the slide, and north 197 feet close to the boundary. At the intersection a body of gold-bearing quartz was met with 12 to 15 feet wide, and continued for 100 feet south, varying from 4

to 12 feet wide, and assaying from 8 to 24 dwts. gold per ton. This stone was proved to go down 30 or 40 feet, and up about 50 feet, when the value and width of the reef declined. The reef in the drive between here and the boundary was reported as varying in size from 5 to 12 feet, and in value from 5 to 14 dwts. per ton. In the end it is 6 feet wide, clean stone, but for a chain back considered too poor to stope.

The south drive on reef showed the channel to be variable, from 4 to 12 feet wide, with stone sometimes highly payable, then bunchy and uncertain. A good block of stoping ground above this level was opened out for a length of 250 feet. In a great part of the drive the quartz is discontinuous—in nice little blocks of good stone, but too short to open out. The drive constantly receives heads and channels of pug from the west, which sometimes carry good stone, and seem to be of the nature of connecting spurs between No. 1 and No. 2 west reefs. For the last 200 feet in this level the only stone met with has been in little isolated bunches, but it is 6 feet wide a little distance behind the slide. The slide, which crosses the level 10 feet behind the end, on a north-westerly and south-easterly bearing, cuts off the large clean stone, but allows stringers and a band of quartz to pass through and curve round to the south-west. The rock-wall on the western side of the level passes through the slide with just a break, but no disturbance. I was told that the quartz was poor up to the slide.

Two crosscuts west from this level have intersected No. 2 west reef; one at 195 feet from flat sheet, driven 28 feet, and communicating by a pass with the level below; the other at 110 feet further in, and driven 40 feet. The first crosscut showed the reef with about 4 feet of stone in it, and the second exposed only a few inches of quartz with an easterly underlay.

The No. 2 reef intersected in the main crosscut is a mixed quartz formation, with a channel 6 feet wide at the end of the drive north, 54 feet from intersection. The quartz in this channel occurs as leaders and bands—about a foot of stone in the largest bands. Another 50 feet of driving would bring this drive into the main level north.

The indications are that what is known as the No. 2 west reef is an integral portion of No. 1, a long narrow horse of country dividing the two parts.

The long main crosscut west intersects at 135 feet from the west boundary a small break or slide, considered to

be the main slide. It is not quite on the line of that slide as cut at the end of the level south, which, if prolonged, would touch the western boundary. Having regard, however, to the distance between the two points, it is quite possible that the two faults are identical.

1500-*feet Level.*—Only the west reef has been driven on at this level, viz., for 370 feet south of the shaft and 180 feet north, or to within 30 feet of the north boundary. In the south drive stone 4 to 15 feet wide was proved of varying quality, a good deal of it low-grade. The ground above this level has been stoped up to the level above in the south drive. North of the shaft a shoot of gold-bearing stone for about half the length of the drive has been proved, beginning about half-way in.

1600-*feet Level.*—This is the deepest and most important level. The crosscut east of the shaft intersected the east reef at 150 feet, and that west of the shaft passed through the west reef at 140 feet.

The east reef where struck was 5 feet wide, and gold-bearing up to 5 or 6 dwts. gold per ton. It has been driven on 150 feet south without any improvement in quality—in fact, the gold going south has disappeared. When I saw the end, the reef was 6 feet wide, with 5 feet of quartz in bands, and there was still quartz outside the walls of the drive. Water from the reef channel was dripping from the roof; the stone was a little mineralised and of favourable appearance.

A drive north was recently started on this reef, and a winze begun 10 feet from the flat sheet. The stone showed gold freely, and a small crushing from the drive (43 tons) returned 1 oz. per ton. The gold in the winze is rather erratic, disappearing and reappearing at intervals. The north drive has been extended to 30 feet without improvement. The wall on the east side is well defined and smooth. A few feet back from the face a head crosses the drive and has checked the stone, but the face is black with mineral. The reef in the winze is 4 feet wide, stone clean, wall defined, and everything promising. The occurrence of gold here is the most important feature of the mine at the present juncture, but this will be referred to later on.

The crosscut west from the shaft at 140 feet cut the west reef, which at this point is 10 to 12 feet wide, with about 5 feet of lode-slate. The quartz is low-grade. This reef has been driven upon north for a distance of 140 feet, but has supplied nothing to the battery. The drive

is on a large reef, and the face carries a large formation on the footwall. On the west side at the end gold-bearing stone was found, worth about 5 dwts. per ton, and a rise goes up on this to the level above. A point of stone comes into the drive from the east, and at the end of the drive a crosscut east has been driven about 30 feet; the face of this is in quartz-veined slate. It is probable that the point referred to is the cap of a quartz body going down below this level. The end of this drive is 70 feet from the north boundary, and there is every reason to believe that the reef is the one upon which the Tasmanian Consols has driven north, only this drive is 172 feet below the 1400-feet level of the Consols, and 17 feet further west. The main crosscut has been carried some 20 feet further west through reef and lode slate formation. The indications are that the two parts of the west reef have junctioned here.

The solid and wide reef followed in the north drive with moderate, though not payable, assay values, augurs well for future work at a deeper level.

After the above review of the deeper levels we are now in a position to consider the general prospects of this great mine.

These at present are visibly dependent upon the east and west reefs. The former has been stoped roughly (neglecting certain gaps) a vertical distance of 250 feet from below the 1000-feet level down to the 1300-feet level for an average length of 250 feet; but below this no stoping has been done, as though the reef is powerful and clean, the gold-shoot seems to have thinned out. The pitch of this shoot is to the south, and the main slide is practically the southern end of it, though gold-bearing quartz continues westward a short distance in the slide-channel before it finally dies out.

Efforts have been made to pick up the heaved reef on the south side of the slide, but in vain, and after examining all the conditions, I am of opinion that there is very little chance of finding it, as the indications are that the reef has deviated along the channel, and has really not been faulted at all. It has been followed in various levels to the end of its deviation. This does not, however, preclude there being a continuation southwards south of the slide country; not the same reef perhaps, but in the same line. The reef-making process which was at work certainly extended southerly and south-easterly, forming the long north and south reefing-line referred to before in this

report. Consequently, it is quite possible that the South Gate Mine, deepened to 1000 feet, might open up reefs of the same character as those in the New Golden Gate. The reefing-line is in a direction east of south. The long crosscut west from the 1200-feet level has failed to pick up anything in its course, and this result is not encouraging for discoveries on the western side. Crosscuts to the east have a much better chance, and this has been recognised by the Gate management.

As regards the main shoot of gold in the east reef, it has not been proved below the 1400-feet level. A winze was commenced at the end of this level, in order to prove the reef down to the level of the 1600-feet, and in the event of success, the latter would be driven south to connect. Unfortunately, the walls of the reef at this spot showed signs of converging, and the funds available do not allow any risk of unprofitable work being taken. Consequently, sinking was suspended, and properly so, under the circumstances. All the same, however, this work is desirable whenever funds will permit it. Still, it would appear as if the gold shoot has been for some time contracting as it descends, and it is possible that it will have disappeared altogether by the time the 1600-feet level is reached.

It is useless to disguise that the company has to face the possibility of one of those blanks in the reef such as have occurred in other mines, and have been perseveringly passed through to payable stone at a greater depth. An uninterrupted gold-shoot in one reef or the other for at least 1200 vertical feet, as has existed in this mine, may be described as a persistent run of the precious metal, and a blank sooner or later would have to be expected; but both experience and theory teach us that the blank is only a passing phase. The magnitude of the scale on which gold has been deposited from the 1300-feet level upwards forms the very best reason for believing that deeper sinking will eventually lead to another gold-bearing zone.

The most important feature in the whole mine at present is the discovery of gold in the reef at the 1600-feet level, 400 feet north of the main shoot at the 1300-feet. Stone worth 1 oz. per ton was met with here, but the gold gave out and is now being sought by a winze. The fact of gold occurring at this point, unconnected with the south shoot, makes it nearly certain that the discovery is a parallel shoot. It may therefore be the cap of a new make of gold descending from this level indefinitely. The

management is doing its utmost to locate the shoot with certainty. When this is done the mine is likely to receive a new lease of life.

There are thus at least three or four directions in which capital may be expended advantageously, viz: —

1. Locating the new gold-shoot at the 1600-feet level.

2. Sinking the main shaft deeper, to explore and prove this shoot in depth.

3. Pushing out exploratory crosscuts east; and perhaps,

4. Sinking on the old south shoot from the 1400-feet level.

I am inclined to think No. 4 is the work of least immediate promise, and would be very likely to turn out disappointing; still there is a possibility.

Nos. 1 and 3 are being attended to by the management, and all that can be done is being done, and done thoroughly.

No. 2: The work of sinking the main shaft deeper, so as to get at the new shoot of gold below the 1600-feet level, is of prime necessity, and may be strongly commended to the owners.

From the above remarks it will be seen that the only policy which can save the mine is an exploratory one. It is ridiculous to talk of the mine as having come to an end while there is a strong reef with patches of gold at its deepest level. The situation would never have arisen if a strong reserve fund had been built up in the palmy days of the mine; but it must now be accepted, and funds provided for a definite policy of exploration.

From the behaviour of the reefs and a review of the structural features of the mine generally, one may feel almost sure that northern parallel shoots of gold exist, and there is no reason why they should not prove as important as the one already worked. It is for the mining engineer to search for them in the most profitable and approved way; and I would lay the greatest stress on this work. Immediate further sinking of the main shaft is involved in this view.

With reference to the west reef, it has, on the whole, been disappointing as regards its yield of gold. Still, it has sent a good deal of quartz to the battery from the 1300-feet level downwards; and the quantities of stone being taken from it in the Tasmanian Consols Mine further prove its importance. A comprehensive policy for the Gate mine must include the development of this reef. The fine body of quartz in it at the 1600-feet level, north

drive, invites further work. Although low in grade at that point, it may improve at increased depth; at any rate, it is too encouraging to be left alone.

The New Golden Gate Mine has a very complete gold-saving plant, consisting of 40 stamps, 8 boxes (5 stamps in each), 3 copper plates to each box (none inside), one Watson and Denny pan for the blanketings, a hydraulic classifier to each 10 heads, 1 Wilfley table and 1 Frue vanner to each 10 heads. The cyanide plant comprises 4 distributing and 4 leaching-vats (100 tons capacity), 6 slime-vats with agitators (12 tons), and 3 zinc-boxes. The quartz is tipped direct into hopper, and without passing through a stone-breaker is hand-fed into the battery, one feeder being employed for each 10-head of stamps. The stamps vary in weight. Mr. T. J. Andrews, the general manager, says that a few years ago stamps of 750 lbs. were in use, with a drop of 8 inches, and 75 blows per minute, but that some of them have been replaced by heavier stamps, increasing the weight by a heavier shank, and a solid disc instead of the screwed disc, and at present most of the stamps are a little over 900 lbs. in weight, with 6 inches drop, and 90 blows per minute.

The quartz is crushed through a 200-hole grating, and passes over two ripples, then over the copper plates and blanket strips. The blanketings are ground in a Watson and Denny pan, and amalgamated with mercury. After the blankets, the sand passes to the hydraulic classifier, and two classes are formed, No. 1 going over the Wilfley tables, and the slime-pyrites over the Frue vanners. The tailings are then pumped to the cyanide plant, each distributing-vat holding 100 tons of tailings, which are trucked into leaching-vats in front and below. The slime passes in the overflow, and is caught as far as possible in a series of 6 settling-vats, each provided with an agitator driven by an air-winch. The tailings are leached with cyanide, and being fairly clean, do not require any special previous treatment. The gold is extracted in zinc boxes. The tailings residues are trucked from the leaching-vats and drawn up an inclined tramway with air-winch for tipping. The slimes are agitated and allowed to settle before decanting solution: these are not rich enough to warrant filter-pressing.

The 40-head battery, crushing full time, treats 420 gross tons per week of six days. The battery amalgam is worth about one-third gold, and the gold realises about

£3 16s. per oz. The cyanide bullion is worth a little under £3 per oz. The concentrates are sent for treatment to Cockle Creek, N.S.W.

An electric pumping plant has been recently installed in the main shaft, and is a complete success. The manager informed me that he could raise 2500 gallons per hour with it, but that the hourly quantity to be lifted was only about 1200 or 1400 gallons.

It may be mentioned that for several years the quartz raised and treated has cost between £1 8s. and £1 9s. per ton, including management expenses.

South Golden Gate Mine.—The Section 295-87G now belongs to the New Golden Gate Company, and the old South Gate shaft is situate in the north-eastern corner, 114 feet south of the north boundary-line. Work has been relinquished, and my information is derived from Mr. Andrews and the mine plans. The main shaft has been sunk 400 feet, and crosscuts driven at 200 feet and 400 feet. In the 200-feet crosscut and at 20 feet from the shaft a 6-feet reef formation was passed through, carrying some quartz, but no gold. This runs approximately with the country, and underlies east. It was driven on a short distance, with no results. It appears to be the Snake reef, which was sunk on by the Snake shaft 20 feet north of the boundary; and what is thought to be the same reef was exposed in a small shaft or pit opened by the roadside just south of the Gate residence. No certain information is available respecting the results of the old Snake shaft, but it is said that some half-ounce stone was got from it.

At the 400-feet in the South Gate shaft two long crosscuts were driven east and west. The west one was pushed 194 feet, or within 11 feet of the western boundary, without cutting anything beyond a wall at 107 feet from the shaft. In the east crosscut at 130 feet from shaft a reef formation, about a chain wide, was passed through, which must have been the Snake reef; and 84 feet further in a second formation, 75 feet wide, was intersected. Continued driving for further 150 feet failed to disclose any more reefs.

If the bearing of these formations is reported correctly as N. 25° W., we cannot connect them with any of the reefs worked in the New Golden Gate. The Snake reef is not far from the position which the main slide might be expected to occupy, but its underlay is easterly. The real relations of the South Gate reefs to the slide are

doubtful. We do not know their strike sufficiently well to be able to produce them northwards towards the Gate mine. As far as can be judged from appearances, they would intersect the Gate reefs on their underlay if they persist so far. It is regrettable that they were not explored more fully. As the Snake reef was gold-bearing where worked from the shaft, other parts of the reef will almost certainly be found gold-bearing also. The formations are mullocky or slaty where they have been cut, but as their strike is more or less with the country, it is probable that they will last for some distance, and may make more quartz at some point or other. I have charted them as south of the slide, assuming the bearing of the latter to be uniform throughout, but I am far from certain as to where the main slide would strike these reefs.

Tasmanian Consols Mine.

This company leases Sections 70-87G, 174-93G, 173-93G, 1008-87G, 57-87G, 204-83, 130-G, and 75-93G.

The work is being done on Section 70, at the shaft begun by the old North Golden Gate Company. The levels of the different crosscuts from the shaft are as follows:—150 feet from surface, 390 feet, 540 feet, 900 feet, 1000 feet, 1100 feet, 1200 feet, 1300 feet, 1400 feet. The New Golden Gate shaft is 190 feet south of the boundary, and the Tasmanian Consols shaft 62 feet north of it, so that the two shafts are not more than 252 feet apart, but the collar of the Tasmanian Consols shaft is 28 feet below that of the Gate. Accordingly, the levels in each mine do not correspond exactly with each other.

The west reef of the New Golden Gate has been developed in this mine at the 1200, 1300, and 1400-feet levels. It cannot be connected satisfactorily with formations seen in higher levels. As this is the only productive reef so far worked in this mine, I will take these lower levels first.

1200-*feet Level.*—At this level crosscuts have been driven west 130 feet and east 40 feet. The west crosscut, after passing through 50 feet of dark slate, dipping west, intersected a wall, and traversed an irregular reef formation for 15 feet. On the east side a vein of quartz about a foot wide, and carrying a little gold, has been cut. Then a further vein, 6 inches, was cut, and on the west side is mixed formation about 6 feet wide. The reported

values of the quartz are from 8 to 10 dwts. per ton. The crosscut was continued with the object of cutting another reef further west. The face is in dark, smooth slate, dipping west: 3 feet behind it is a 5-inch vein of quartz underlying with the country.

Levels were driven on the reef north and south. The south drive, 50 feet, to the boundary, has not opened up payable stone. About half-way in is from 6 inches to a foot of stone on the footwall, and a bunch of mottled quartz is in the face on footwall side, about 1 foot wide.

The north drive, at 30 feet from crosscut, carries 2 to 3 feet of mineralised stone on footwall, with a little gold; and at about 60 feet this improved to a body of payable quartz the full width of the drive. Stone was sent to the battery from the stopes above this level for a length of 80 feet by 20 feet high. The south end of the stopes comes to within 30 feet of the crosscut. At 90 feet from crosscut a rise has been put up 42 feet through the stopes. The reef was payable up to 20 or 25 feet, then fell off in grade and size. At 12 feet it was 5 feet wide; at 18 feet, 3 feet wide; at 25 feet, 2½ feet wide; at 40 feet, it is broken and valueless. Some rich stone was disclosed by this rise, some of the assays returning between 1 and 2 ozs. gold per ton; but values, on the whole, were irregular and poorer than below the level. The stope ends 30 feet north of the rise; and 20 feet further north a crosscut west was driven off the level for 21 feet in slate country with quartz veins, but with no result. About 15 feet behind the rise the reef appears to be divided, a splice going off east. A few feet north of the crosscut, on the east side of the level, a reef goes off to the east with 2 feet of clean low-grade stone. It may be wider, but has only been cut into for 2 feet. This appears to be a splice taking the place of the main reef, which crosses the level to the west. Ahead of this make, only bunches of quartz occur in the roof. Further north, at 220 feet from the main crosscut, a crosscut east has been driven for 75 feet. The main level continues north past this crosscut for 38 feet in clean slate country without any sign of a reef. It would seem here to be too far to the west.

The 75-feet crosscut was driven to intersect the east reef formation cut east of the main shaft. At one time it was suggested that this was the east reef in the New Golden Gate; but this cannot be the case, as that reef would be 90 or 100 feet east of the shaft, or only just inside the eastern boundary of the section. A reef has

been cut 3 feet behind the end, carrying 9 or 10 inches of quartz, with a north-west bearing. I doubt whether this is the same as the one in the crosscut east of the shaft; but it is probably identical with that cut at the end of a drive north of this crosscut, 50 feet back from the face. From that point the drive has been extended 107 feet north. This drive is supposed to be in the footwall part of the west reef, or on the east splice of the reef. About two-thirds of the way in, the reef rises in the floor and disappears again; and some quartz is seen in the level in two or three places. At the end a cuddy has intersected the east reef formation, 2½ feet wide, which is here stronger and carries more clean quartz than in the crosscut. The cuddy has been pushed through to the clean slate on the east side, which is smooth and identical in appearance with that at the end of the crosscut. The quartz carries a little gold.

The crosscut east from the main shaft cut a lode at 27 feet, which has been thought to be the one cut at the end of the level north. If the latter is the same as the one cut in the other crosscut, this reef could very well be a different one, for the bearings are not identical. The relations of the country-rock, however, are similar in all three exposures, and this suggests identity in some way, for here, too, the sandstone of the crosscut gives way to dark, smooth slate where the reef is cut. The reef has been driven on east of south for 15 feet, carrying about 6 inches of white unpayable quartz for half-way in, which then degenerates into stringers. The underlay is to the east. To cut the east reef of the New Golden Gate at this level, it would be necessary to drive the crosscut further east for about 70 feet, but the reef would then be found to underlay out of the section. The reef which has been cut in the Tasmanian Consols east of the shaft is most likely the formation met with in the Gate crosscut near the shaft.

The work done on the west reef in the Consols has followed it at about 100 feet nearer the surface than in the New Golden Gate, but this appears to be the cap of it. At the 1200-feet level the stone forms a low crown, or apex, which was disappointing above the level, but has been found to improve and lengthen going below it.

1300-*feet level*.—The crosscut west cut the west reef at this level at 58 feet west of shaft. At the intersection the channel is about 20 feet wide, carrying an irregular

formation of quartz veins, but payable. The length of payable stone has increased at this level to 220 feet. The reef was strong for 60 feet along the level as far as No. 1 winze, where it is 6 feet wide, and of good quality. Northwards from there it pinches, but after 40 feet it opens out again to 7½ feet, yielding very good stone; after another 40 feet, it contracted again. The northern end of the stope is in reef matter carrying a little gold, sufficient to go to the battery with other stone. North of the stoped ground the reef in the level varies from 3 to 5 feet in width, sometimes broken and irregular, and giving varying gold prospects. The face carries a well-defined footwall, and about 2 feet of stone altogether. Behind the end a flat floor comes in, cutting down through the lower part of the drive. The quartz is gold-bearing, but not payable. This is rather a long drive without any crosscuts.

At the bottom of the 40-feet winze (No. 1), from this level, there was, at the time of my visit, a fine reef of solid payable stone, 9½ feet wide, opening out going south to 16 feet.

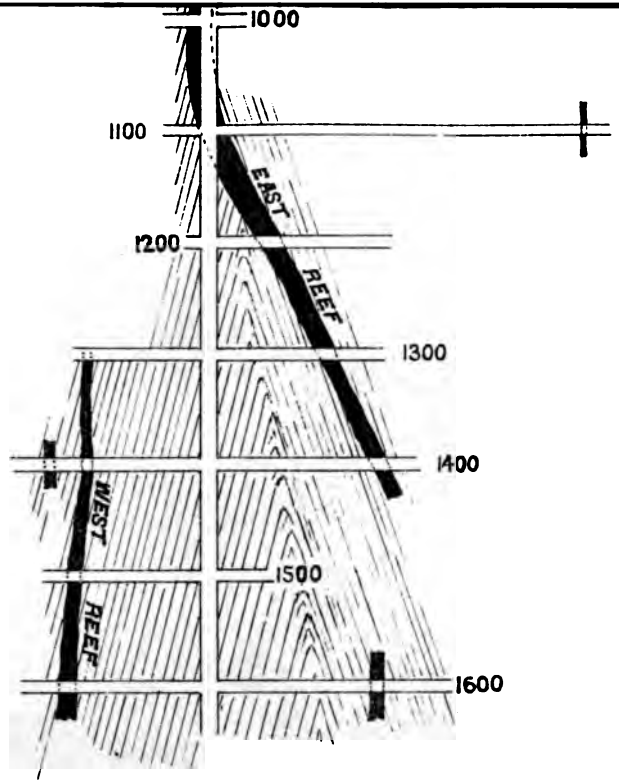
The level south from the crosscut has been driven to the boundary, where the horse of lode slate intersected at the flat sheet terminates, and the two portions of the reef come together. In the face the division is just showing, the eastern side of the reef dipping east, the western side underlying to the west. The reef is 13 feet wide, but is not payable in the end; or, rather, the stoping-ground seems to have come to an end here, a stope running back from here north for 70 feet, and up to 80 feet above the level, communicating with the intermediate end from No. 1 winze.

The north end of the 1300-feet level on this reef in the New Golden Gate Mine is 28 feet higher than this face, and 70 feet on the south side of the boundary. It is still poorer, and probably there is not much of importance between them, as the gold is making north in a cone-shaped shoot, the base of which lengthens in descending.

1400-*feet Level.*—This is the bottom level. The crosscut west intersected the reef at 43 feet, or 15 feet to the east of where it was passed through at the level above. The survey shows that this apparent change of underlay is not real, but due to difference of angles at which the crosscuts have been driven, the reef being practically vertical, or dipping west very slightly. Where the cross-

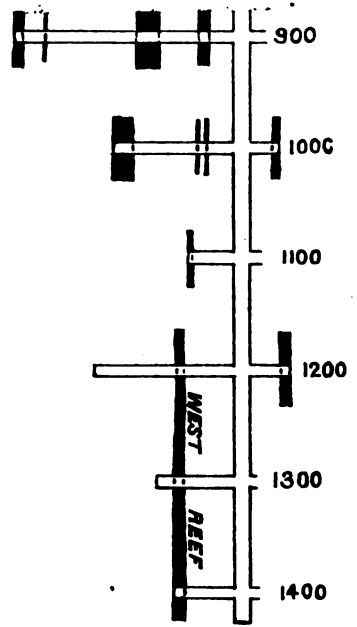
cut passed through the reef, the latter consisted of between 11 and 12 feet of gold-bearing stone. Levels north and south have been opened on it. When I saw the reef, soon after its intersection, it was a splendid body of quartz, 10 feet in width, well mineralised. The battery tests of it seem to show that it is worth about 10 dwts. per ton. Since my visit the south drive has been carried to the boundary. As the New Golden Gate has driven its 1400-feet level also to the boundary, on what is presumed to be the same reef, the two ends must be one above the other, separated by a vertical distance of about 28 feet. From the plans of the surveys of the underground workings of both mines, the reef at the 1400-feet level in the Consols is identical with that in the Gate at its boundary in its 1400-feet level, for the measurements give only 3 feet horizontal difference between each, the reef in the Gate being at that point 240 feet west of the north-east corner of Section 13-87G, while in the Consols it is 243 feet. This difference is not what I should have expected, for the Consols appears to be working on the eastern part of the reef (if there is any split), and on that supposition its reef should be to the east of the one in the Gate. But a few feet difference may exist in the survey, and absolute certainty cannot be attained unless a connection is made between the two mines. Whether, however, the workings are on one part or the other of the reef, and however the reef behaves, it is the west reef of the Gate that has passed through to the Consols.

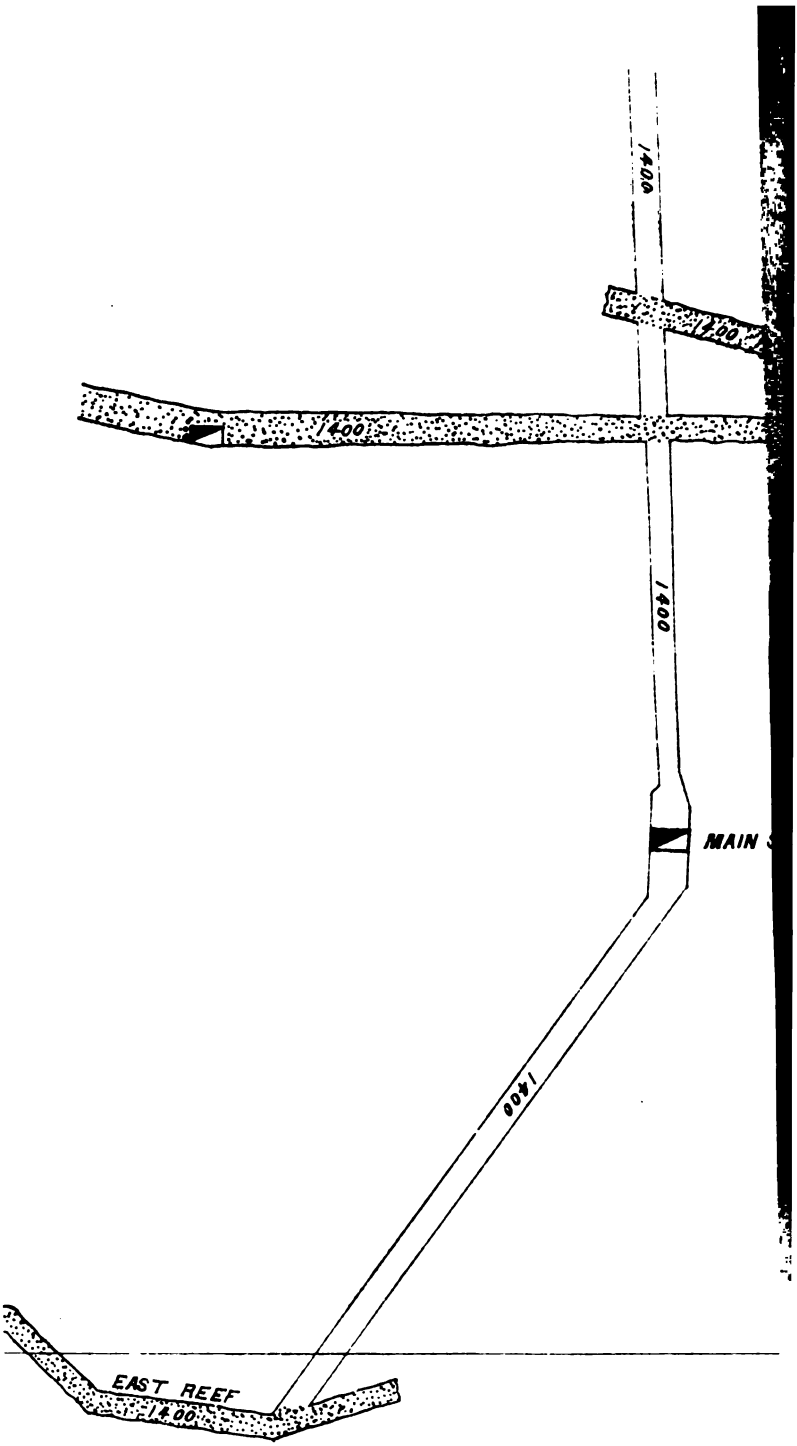
An intermediate level is being driven at the Consols 50 feet above the bottom one, and is on a fine body of stone. The level north, at the 1400-feet, is also being pushed forward. This must be continued irrespective of any variations in the reef, as the length of the shoot has to be proved and developed in that direction. The form and direction of the gold shoot in this mine have not yet been precisely determined. From the analogy of the New Golden Gate we should judge that it will be found to pitch southwards. As far, however, as work has proceeded, it seems to show an approximately vertical shoot, widening north and south as it descends. More work is necessary before an opinion can be formed. The quality of the stone crushed varies within narrow limits but is of payable grade, as may be seen from the following statement of crushings from the beginning of the company's operations to the end of last year, kindly supplied to me by the local agent, Mr. H. J. Wise.

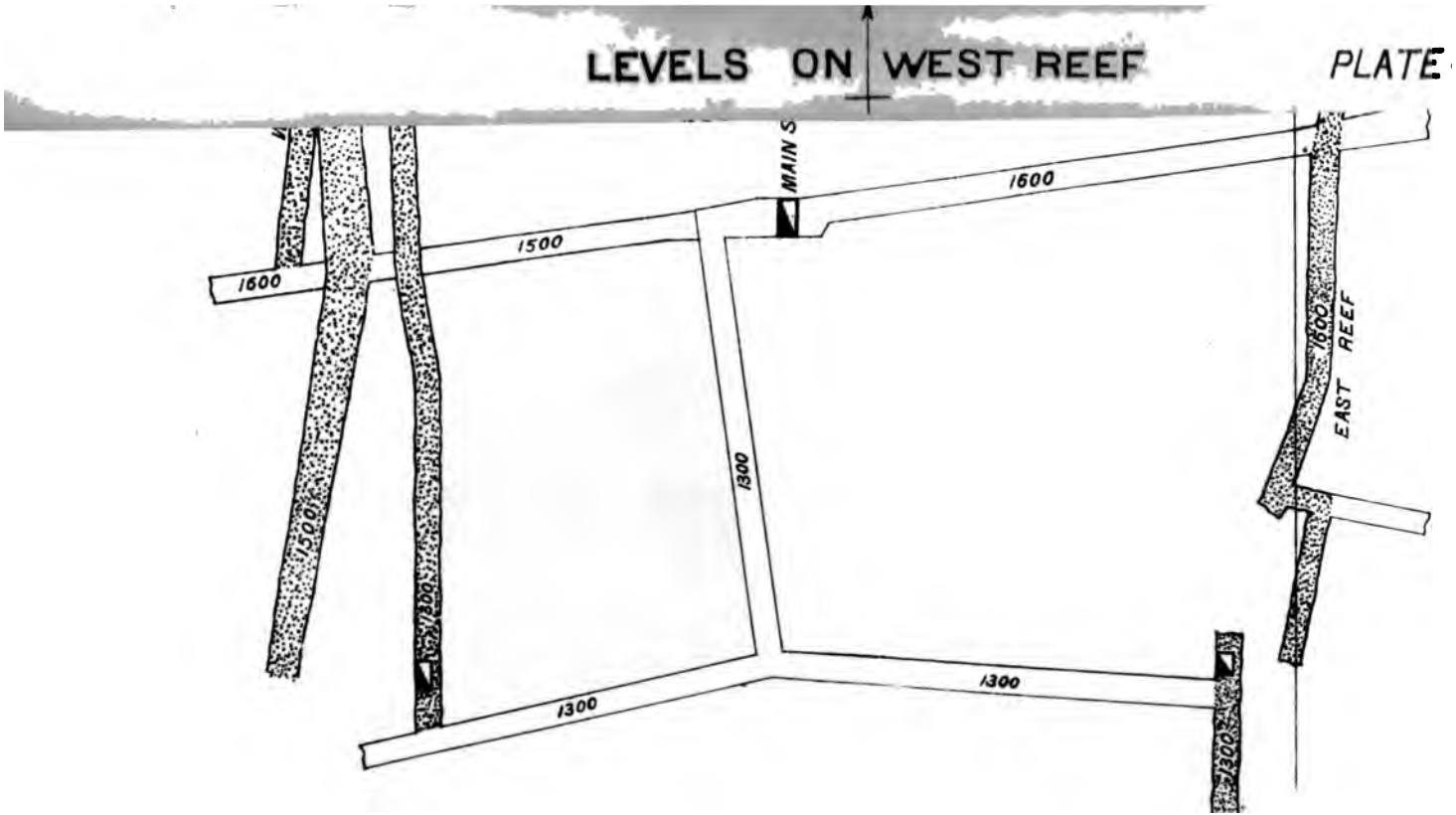

1000
1100
EAST
REEF
1200
1300
1400
WEST
REEF
1500
1600

TASMANIAN CONSOLS REEFS

PLATE 2

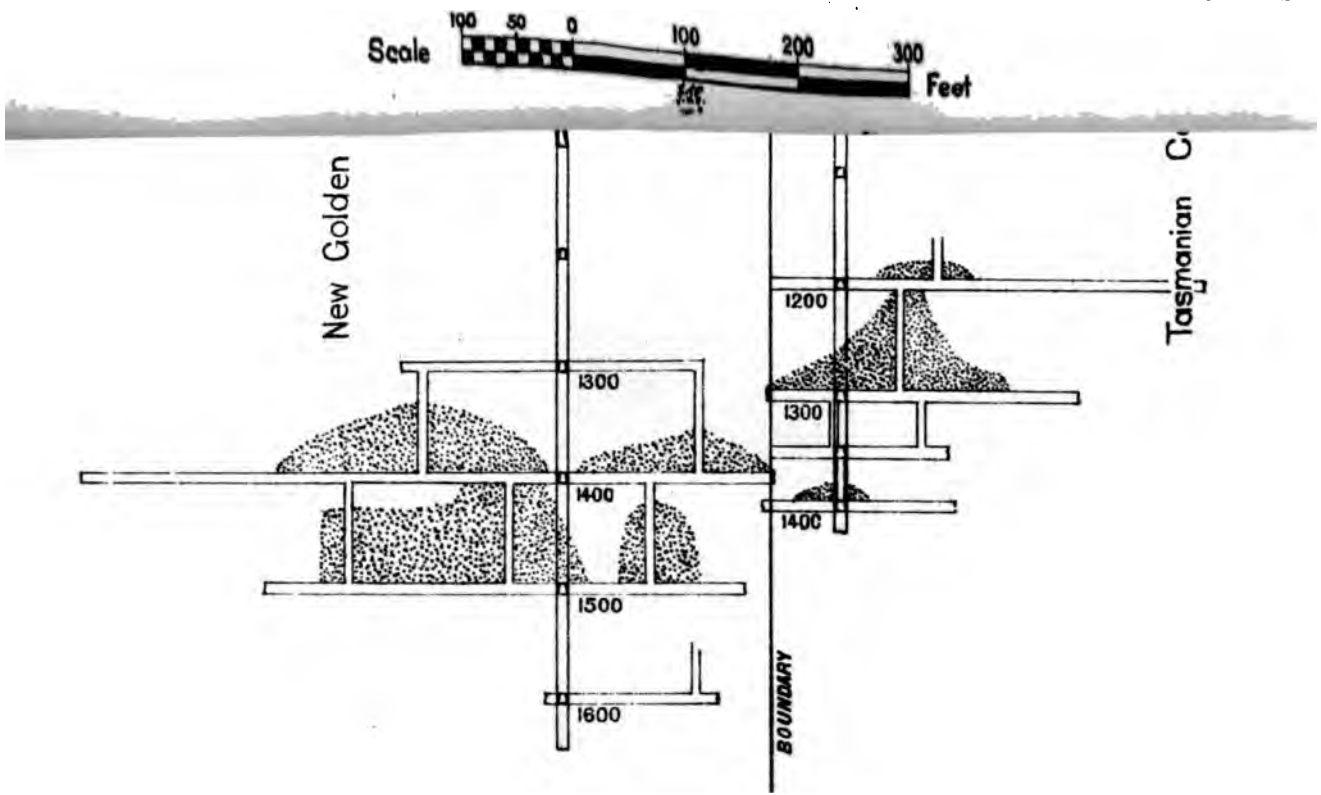



1400
1400
1400
1400
1400
MAIN
EAST REEF
1400


LEVELS ON WEST REEF
PLATE
MAIN S
1600
1500
1600
1500
1300
1300
1300
1300
1600
EAST REEF

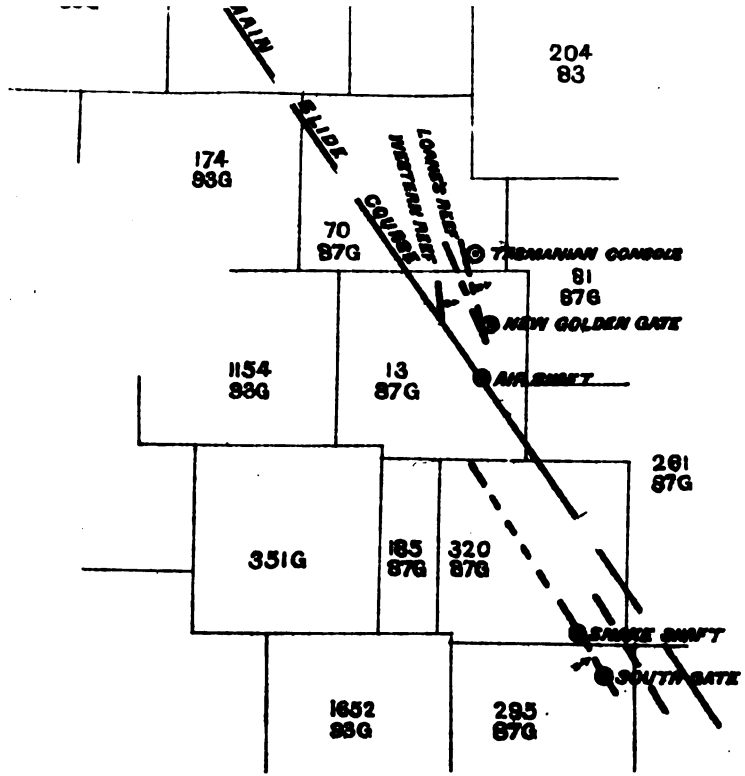
STOPES ON WEST REEF

PLATE 5



18
87G
NEW GOLDEN GATE
SHAFT
TASMANIAN C
SHAFT
392 FEET LEVEL
REEF
POSITION OF WESTERN REEF
AT SURFACE ADIT
13
87G

GOLDEN STAIRS SHAFT
SHAFT
N°1 REEF AT SURFACE
N°2 REEF AT SURFACE
150
N°1 REEF
50
N°1 REEF
230
230
ESTIMATED POSITION OF N°2 REEF AT N°2 LEVEL


MAIN
SLATE
LONNIE REEF
WESTERN REEF
COURSE
204
83
174
93G
70
87G
TASMANIAN CONSOLE
81
87G
NEW GOLDEN GATE
1154
93G
13
87G
261
87G
351G
185
87G
320
87G
1652
93G
285
87G

Date.	Tons crushed.	Ounces won.	Per ton. dwts.	grs.	Value. £	s.	d.
1904—Oct. 27	13	8	12	7	30	3	9
"	13	10	15	9	35	18	3
Nov. 14	200	109	10	21	387	7	2
Dec. 14	660	374	11	8	1352	11	4
1905—Jan. 25	345	172¼	10	0	624	14	9
Feb. 22	510	181	7	2	665	3	10
Mar. 22	508	162	6	9	585	6	5
May 16	460	240¾	10	11	879	10	5
June 14	423	169	7	23	616	9	8
July 26	570	251¾	8	20	918	6	10
Aug. 23	380	209	11	0	764	14	0
Sept. 20	386	192	11	10	703	16	2
Oct. 18	400	219	10	22	804	5	5
Nov. 18	645	312	9	9	1150	14	7
Dec. 20	870	383	8	19	1404	16	6
	(Plate gold)	137	...		483	6	8
	6333	3130	9	21	£11,407	5	9

Average yield, including pyrites, 10·23 dwts. per ton.

From the above quartz, 77½ tons pyrites were obtained, containing 383 ozs. gold; and the average value of the tailings is 2 dwts. per ton. The average value of the pyrites per ton is 4 ozs. 18 dwts. 20 grs.

The presence of the strong and payable reef in the bottom level sufficiently indicates what the company's policy should be. Further sinking of the main shaft is indispensable, combined with exploration to the north. For the latter purpose two levels had better be selected. the 1400-feet for proving the present reef; and perhaps the 1200-feet for driving north into the next section, in order to crosscut to the line of the New Golden Gate east reef, which cannot be reached from these workings in any other way. As it stands at present, the mine is a partly undeveloped property, work, owing doubtless to financial circumstances having been carried on on a limited scale; but the opening up of the ore-body in the lower levels is putting fresh heart into the company, and there is now every reason for undertaking the new work with vigour I would urge that no time be lost in beginning another sink at the main shaft.

Upper Levels.—I now proceed to notice the upper levels, in which the deep west reef cannot be identified. In the 392-feet level crosscut, quartz veins were cut near the west end, which, in Mr. Montgomery's opinion, heralded

the Gate adit central and western reefs. Since then a level has been driven 200 feet deeper, the 540-feet level, which has been extended 24 feet further west, and has cut in its end what would seem to be the same formation.

540 *feet Level.*—This is a crosscut level west, driven 277 feet. From the chamber it passes through a formation of slate, with veins of quartz 16 feet wide underlaying west. I interpret this as the same reef formation as was cut in the level above at about this distance west of the shaft. Mr. Montgomery thought it was a western branch of an extension of Loane's reef. Five feet further in is another formation 2 feet 6 inches wide, which may pertain to the same channel. In the course of the drive various channels and quartz veins occur, some of the latter being lenticular and discontinuous. At 57 feet behind the end is a track of some fault 2 feet wide, crossing the level; and in the end itself is a reef formation 3 feet 6 inches wide, consisting of slate and white lenticular quartz of irregular habit, dipping west. This has evidently come down from the west end of the 392 feet crosscut. From its position it would appear to be the northern extension of the western reef met with in the New Golden Gate surface adit. If the crosscut in the 500-feet had been extended a little further west, the reef channel would have been defined with certainty. Now, if this reef is prolonged northwards on its line, we shall find that it corresponds in position with the reef struck in the west crosscut in the Gate Extended at 470 feet from the shaft. That reef, therefore, is the upper western reef of the Gate mine. It has not been seen at a lower level in the Consols, because none of the lower crosscuts have been driven far enough to intersect it. The 900-feet level crosscut is the nearest to it, having been driven to 196 feet west from the shaft. It is strange that the reef has not been driven upon from any of these crosscuts, as its behaviour and quality where it has been intersected form no proof of its value. It would be unusual if such a persistent reef did not carry economic values at some part or other.

900-*feet Level.*—At this level a crosscut west has been driven 196 feet from the main shaft, and a drive north for 54 feet on a reef channel.

In the crosscut, about 20 feet from the shaft, a formaton is passed through, carrying 4 or 5 inches of stone on the east wall, and 6 to 15 inches on the west wall; the whole channel being about 8 feet wide, and underlaying east. Thirty-six feet further west a formation about 20

feet wide, is intersected, composed of crumpled, twisted, and mullocky quartz, also dipping east. The stone is developed mostly in the roof and walls; nothing much is seen in the floor. The slate strata are much disturbed in this crosscut. The general underlay is east, though now and then the strata are vertical. Twenty-nine feet behind the end is a reef dipping east, with 6 to 9 inches of stone; and at the end is a 7½-feet formation of quartz veins, 1 inch to 4 inches. This is a good looking reef channel.

The distances between the levels reduce the determination of the reefs in this level to a matter of surmise. The channel struck at the end can hardly be the same as that at the end of the 500-feet.

The drive north from west of shaft is on the line of a formation which is 10 feet wide at the end, and merits being driven upon. A winze has been sunk at the end to a depth of 60 feet, and it is said that the stone gave a fair prospect, though it was rather narrow. The shaft at this level seems to be in the centre of the fold of the country.

1000-*feet Level.*—Crosscuts have been driven east and west from shaft, and a short level driven north and south on a load-line east of the shaft.

The crosscut west has been driven 107 feet from the shaft in slate country, dipping west. At 20 feet from the shaft a small quartz reef is intersected, which has 7 to 9 inches of stone, dipping to the west. At about 10 feet further west a little more quartz is met with, and at 36 feet from shaft quartz is seen lying irregularly in flat curves. For 15 or 20 feet behind the end of the crosscut formation country is passed through with mineralised quartz veins, reported as carrying a little gold. When this was cut, it was thought to be the west reef of the Gate, but it is too far west for the lower west reef, and not far enough west for the upper or adit western reef. At the end of crosscut a lode formation about 2 feet wide, containing two veins, about 4 inches each, has been passed through, and a slate wall met with, vertical, or, if anything, dipping east.

The crosscut east has been driven 70 feet. At about 10 feet from the shaft it passed through quartz veins, and 10 feet further east intersected a lode 6 to 9 inches wide, dipping east. Towards the end the slate is very irregular, still dipping east. The end is in clean slate; a few small veins of quartz just behind it. A drive south goes from this crosscut at 17 feet from the shaft for 44 feet, on an irregular formation. A vein of quartz, 3 inches wide,

is seen in the middle of the roof, and parallel veins occur at intervals from this to the east wall of drive. Just behind the end a short crosscut or cuddy, 12 feet long, was driven to the west, in slate, with bunches of quartz.

A drive north from the main crosscut has also been put in for 43 feet, exposing irregular seams of quartz, and a cuddy west, behind the end, shows a formation 4½ feet wide, with quartz veins. This is the reef cut east of the shaft at the 1200-feet level.

1100-*feet Level.*—A crosscut has been driven 40 feet west from shaft, and on intersecting the reef a level extended in a north-westerly direction for 210 feet on the reef track. An east crosscut from shaft has only been opened out for 12 feet in hard slate, showing in the end a miniature inverted saddle of quartz on the south wall. At the shaft the strata are vertical, but on driving west a change to easterly underlay takes place immediately. At between 37 and 40 feet west, two veins of quartz, 6 to 8 inches wide, were cut, one of which was reported at the time as carrying good gold. The crosscut was continued a little to make sure that there was nothing beyond, and then the wall of the formation was followed in a drive to the north-west. The underlay of the reef is west. The level is in an arch of the strata, which underlie east on the east wall. The veins driven on come together, but the stone is small and irregular. After driving 80 feet in a north-westerly direction, another reef formation, 3 feet wide, consisting of mullock and mineralised quartz of poor quality, was passed through, and the drive turned north to follow it. This was, at the time, supposed to be the west reef, though which west reef does not appear from the reports. It is not far enough west to be the western reef in the Gate adit, but it may possibly be a western branch of the west dropper from Loane's reef. It was driven on for 120 feet without any improvement. A cuddy at the end was driven east for 12 feet without disclosing any quartz. In the end of the level is a lode track with a little mineralised stone on the west wall, tailing out, but it may re-appear further on; and behind the end there is a little stone on each wall. It is a disappointing level, and requires crosscuts to clear up some uncertainty as to position.

There are several features in this mine which command attention, and should encourage the owners.

Firstly—A massive payable reef has been opened upon in the deeper levels, now followed downwards, for a couple of hundred feet, with improving results. The fact that

the same reef has been developed in the Gate for long distances with, on the whole, disappointing results, need not influence work here. A shoot of gold has been fortunately located, and it remains to go down further on this.

Secondly—Any amount of virgin ground lies to the north, and development of the reef by extension of the drives on it northward must be undertaken.

Thirdly—If the northern crosscut at the 1200-feet level is extended in a north-easterly direction, the east reef of the Gate can be reached and proved in the Consols property (on Section 204). If that reef is payable there, a new mine will result.

Fourthly—The reef which I believe to be the Gate Extended reef can be driven upon in the 392 and 540 feet crosscut levels; preferably, the latter.

Fifthly—The ground generally east of the shaft is comparatively untried, and when everything is in full swing and funds are available, ought not to be neglected. It has the disadvantage of being a rather narrow strip from east to west on Section 70-87G.

Work during the past eighteen months has greatly strengthened the position and prospects of the mine. Vigorous exploratory and developmental work may be recommended confidently. This, together with sound management, may be expected to achieve good results.

The battery comprises 20 heads of stampers, with plates and blanket strakes. · The blanketings are treated by sluicing. A modern gold-saving plant would be advantageous. The company is at present installing a new winding plant.

Gate Extended Shaft.—This is on the Tasmanian Consols, Section 130-G, 20 feet from the east boundary, and formerly belonged to the New Golden Gate Extended Gold Mining Company. At the time of Mr. Montgomery's report it was sunk to 159 feet. It has since been deepened to 410 feet. From the bottom, crosscuts have been driven east and west; the east one to 311 feet, the west one to 863 feet. These are now inaccessible, but Mr. Wise has kindly furnished me with the fortnightly mine reports, and Mr. Andrews has supplied the particulars of underground survey, so that authentic information of these important workings is available. These crosscuts cut right across the line of the Gate and North Gate reefs, and show us what exists on this parallel at that depth. At 182 feet west of the shaft, a drive was put out 106 feet

to the south-east on a mullocky reef formation, dipping east, about 2 feet in width, carrying bunches and bands of quartz, but of poor quality. It was thought that this would lead to the reef near the old Perseverance shaft further south; but work in the mine was suspended in August, 1897; and in February, 1898, the long crosscut was again taken in hand. At 250 feet from shaft a solid body of stone was passed through, showing 2 feet on the south side of the crosscut, but of poor quality. At 354 feet a vein of highly-mineralised stone was intersected. At 364 feet highly-mineralised quartz was observed; and at 380 feet a 6-inch north and south vein of stone was cut through, associated with lode-matter and small veins of quartz. At 471 feet a lode formation was passed through, with a well-defined wall and 1 foot of reef-matter on it, composed of soft pug and rubbly quartz. This channel corresponds in position with the western reef in the Gate adit, and has been cut in the 392 and 540-feet levels of the Consols Mine.

A drive was started north on the hanging-wall of this formation, a foot of solid stone carrying gold and pitching north. At 80 feet from crosscut the reef consisted of 3 feet of lode-matter and a foot of solid stone on the west wall, carrying gold. At 64 feet a rise was put up for 37 feet in a mullocky reef with broken quartz 3 feet between walls. A cuddy was put in east from the drive, but only disclosed small veins of quartz. The drive was continued north to 177 feet from the crosscut in a formation 3 feet between walls, and described as very mullocky. It was then stopped, and no drive put out to the south on this reef. The main crosscut, continued west, passed through mineralised veins of quartz at 491 feet from shaft. At 560 feet intersected bands of quartz in hard country. At 585 feet passed through several small north and south veins of mineralised quartz. At 696 feet intersected many mineralised quartz leaders; and at 716 feet several small veins of quartz. At 767 feet intersected some barren stone; and at 783 feet, numerous quartz veins. At 835 feet cut through a small vein of quartz; thence to the end, 863 feet from shaft, through clean, barren slate.

The intersection of the reef which was driven on took place at 99 feet east of the western side-line of Section 130-G; and the end of the crosscut is 264 feet due west of that side-line, in Section 1008-87G, a little above and to the west of the new road.

The east crosscut has been driven to 311 feet from shaft, through slate. At 193 feet, a reef-course, 2 feet wide, was passed through, consisting of lode-slate, with a good hanging-wall, carrying a seam of pug, dipping east about 1 in 3. At 206 feet several strongly-mineralised veins were intersected. At 217 feet blue slate, with strong bands of quartz, slightly dipping to the west, was passed through.

A drive south was started at 193 feet on the reef-course to prove the reef worked in the old Caledonia tunnel, which was thought to be identical with this. For 50 feet from crosscut the formation was 3 to 4 feet wide, carrying some mineralised stone on the footwall; but at 86 feet, and thence to the end at 98 feet, it was broken and discouraging.

The main crosscut was continued east in slate, with occasional leaders of quartz; and at 311 feet from the shaft work was suspended in fairly-clean, dry slate.

Two hundred feet south of the Gate Extended shaft is an old shaft, said to be 60 feet deep, evidently sunk for prospecting purposes, but no information is available.

Tasmanian Gold Estates.

The Tasmanian Gold Estates Company, Limited, has taken over some of the leases formerly held by the Tasmanian Consols, and now hold 1007-87G (not transferred), 673-93G, 674-93G, 67-G, 68-G, 69-93G, 318-G, 319-G, 320-G, 321-G.

This is all ground lying to the south of the Consols, and is in a good position for the upper western reefs of the Consols. The reef now being worked in the Consols at the 1300 and 1400-feet levels, if it maintains its north course, will at that depth pass through the Consols Section 75-93G, just east of the eastern boundary of the Gold Estates Section 321-G. As, however, this would be a ¼-mile to the north of the Consols shaft, a precise calculation cannot be made. If the reef in that distance bore a little west it would come into the Gold Estates section. In this section is the Star of Mathinna shaft, over 200 feet deep, from which a crosscut was driven west for a chain, cutting at 20 feet from the shaft a quartz reef 3 feet wide, dipping east. The reef has a smooth footwall, but carries no gold. Twenty feet further west a broken formation, 2 feet wide, dipping west, was intersected. These were at 150 feet from surface. At the surface, reef indications are seen at about 40 feet west of shaft,

and one outcrop is in the creek. These have been thought to be the South Gate formations, but Loane's reef, if its branches re-unite, and if it lives so far from the Gate Mine (30 chains), would pass through this section; and if it continues on a course only slightly to the west of north, might be expected to pass between the shaft and the western boundary of the section. It appears to me that the Gold Estates owners have a fair chance of meeting with something if they deepen this shaft and crosscut to the south-west under the Long Gully, and across the line of reefing country. I presume the same intention of proving this country by crosscutting under the Long Gully flat was present in the minds of the owners when they commenced sinking the new shaft north of the cemetery. This is on the top of the hill 15 chains south of west from the Star of Mathinna shaft. It has been sunk to 120 feet, but work is now suspended. One hundred and fourteen feet south-west is an old shaft, which was sunk 60 feet on a small vein running north-west and south-east, and underlaying east. This is reported as having had a fair gold value. A prospecting shaft has been sunk 100 feet close to it. The new main shaft would enable this vein to be proved, if sunk deeper. There is an outcrop under the Catholic church, which is on the Gate line of country, and appears to run with the country. I am not at all certain what this reef is. It would be eventually intersected by a crosscut east from the shaft. The shaft is too far west to be used advantageously for testing the extensions of the Gate reefs, but it has a use of its own in testing the ground on the north-west line from the Gate. New makes of quartz are likely to be developed along this line, which is the belt within which the reef-channels occur. It would appear, therefore, that the Gold Estates Company has at least two points where new work may be recommended, viz., this shaft on the hill, and the Star of Mathinna shaft over the valley.

The company has another old shaft at the back of Polley's Hotel, now filled in. It was sunk to 100 feet on a small gold-bearing vein, running north-west and south-east, with a westerly underlay. The eastern and central sections of the Gold Estates Company are situate within the Gate reefing-belt, and this position warrants deeper work. It is possible that the Gate reefs may not extend continuously so far north; but even in that case their place may be expected to be taken by fresh fracture-lines and makes of quartz belonging to the same general system, offering every encouragement for exploratory work.

Hen and Chickens.—On the northern section of the Gold Estates, 68-93G, a tunnel was at one time driven from the main road beneath where the Chinese store is now; and winzes were sunk on an east and west lode, which intersects a main north and south reef. It is reported that 3-oz. dirt used to be won from the Hen and Chickens workings, but at excessive cost.

Loane's Workings.—On Section 1295-93G prospecting was carried on in the old days, and a little fine gold won. Recently Mr. A. Loane cleaned out the trenches and picked up a gold-bearing vein underlaying west and bearing south-east, a little east of the Star of Mathinna shaft, and a good deal east of the Gate Extended shaft. It is considered to be the reef driven on south from the east crosscut in the Gate Extended. It may possibly be the same, but the drive in that crosscut was only 193 feet east of shaft, and the reef underlay east, whereas this vein dips west, and if true to its source, would run 50 or 60 feet further east of the shaft. The distance between the two, however, is 30 chains, and it is impossible to be positive.

Golden Stairs Mine.

Sections 137-G, 136-G, 10 acres each, charted in the name of W. J. Todd; and 156-G, 10 acres, charted in the name of J. Coombe. This property is at the northern end of Mathinna township, occupying the flat land on a level with High-street, which traverses the sections. It is within the reefing-belt of the Gate line, about a mile north-west of the New Golden Gate Mine. Slate country prevails in the eastern part of the property, and sandstone in the western part. The underlay of the strata is to the west, and this indicates, together with other considerations, that the western part of the sections lies a little to the west of the Gate axial line. The eastern part lies fairly within the productive slate zone, in which the great reefs have been worked further south.

Operations were started here many years ago, and the old Golden Stairs Company put down a main shaft on Section 136-G, about 14 years ago, to prove the main north-west reef, and 3 cross-reefs (east-west), over which, in the alluvium, a large quantity of gold had been obtained. The cross-reefs have been worked down to a depth of 30 feet with good results.

The main shaft has been sunk through slate to a depth of 230 feet, and crosscuts driven west at 150 feet and 230

feet. According to the mine survey, the crosscut at 150 feet intersected the main reef at 94 feet from shaft. The reef was then driven upon north for 55 feet. Mr. Stephen Richards reported the reef formations, where intersected, as being 8 feet wide, with 12 inches of quartz on footwall and 2 feet on hanging-wall. The quality is not known, as no battery test was made. The reef being wider and better in the floor of the drive than in the roof, the shaft was deepened, and a crosscut from the bottom cut the reef at 111 feet from the shaft. It was here found to be irregular and poor. It was driven upon 80 feet north and 29 feet south. To intersect the cross-reefs, it would require to be driven 170 to 220 feet further north, and this ought to be done, but at a greater depth. The main crosscut was continued west for a further distance of 115 feet, passing 30 feet beyond where it was expected to cross through No. 2 reef, which junctions with the main, or No. 1, reef at 100 to 120 feet south of the shaft. This crosscut, it will be noticed, proves the ground west of the shaft, but the ground east of the shaft, which is the slate belt of the Gate, has not been tried. A long crosscut should be driven east from the shaft to test this ground. This is an important piece of work, and should not be omitted when operations are resumed at this mine. If this is done, and the main reef is also followed north and south in the bottom level, the mine will receive a good test. The position of the property, and the amount of gold won from the reef detritus at surface, warrant finding sufficient capital for exploratory and developmental purposes. If the exploratory work gives any encouragement, the main shaft sould be deepened at once, as the indications are that it is not quite deep enough for the reefs to be settled and free from disorder.

Close to the back of the gardens, north-west of the main shaft, is an old prospecting shaft, sunk either on the main reef or on Markey's cross-reef, from which a crushing was taken, worth, I am informed, 3 or 4 dwts. per ton.

Sixty-two feet south-west of the main shaft is another old prospecting shaft, upon a reef about 4 feet wide, which has been stoped at surface under the mullock-tip. It is said that the stuff crushed went 3 to 6 dwts. per ton. This reef junctions with the main reef 89 feet south of this shaft, but has not been cut in the bottom crosscut, and the upper crosscut was not extended far enough to intersect it. The stone from this reef was crushed at the City of Melbourne battery.

Three hundred and forty feet north of the main shaft is the Welcome Stranger shaft, on the north side of Wilson-street, in Section 137-G. Some loose specimens at surface, aggregating 11 or 12 ounces, were found, and led to the discovery of a reef-channel, N. 77° E. I am informed that the outcrop dirt, after being washed. went 12 dwts. per ton. A shaft was then sunk to a depth of 40 feet, at about 20 feet north of the outcrop, and the track of a reef was cut in a drive, but no gold being found, work was abandoned. About 14 years ago, on an assurance that gold had been left in the bottom workings, these were cleaned out, but only a reef-channel with two walls was disclosed.

South of the Welcome Stranger shaft, by the roadside, some white quartz, carrying coarse gold, was sunk on to a depth of about 20 feet.

North of the Welcome Stranger is another formation. Good alluvial gold has been found in the flat to the east, but the alluvium to the north becomes too heavy for tracing reef outcrops.

At the corner of Wilson and Mangana streets an underlay shaft was sunk three years ago by Messrs. Markey and Todd, on an east and west reef, with northerly underlay, but no crushings were taken out. An outcrop is visible on the opposite side of the road. A little gold was found here by the former manager, Mr. S. Richards. South and east of this, the ground has been sluiced, and still gives good surface prospects.

On Section 156-G, Messrs. Markey and Todd sank a small shaft east of Mangana-street, on barren stone.

It is perhaps going too far to say that all the gold found in the alluvial covering on these sections has been shed from the known reefs; but unquestionably, the coarse gold which has been washed from the rubble over the reef outcrops has been derived from the reefs in question. The various discoveries of stone north and south of the main shaft speak in favour of a resumption of underground work. I look upon the property as an undeveloped one, which warrants going to the expense of a thorough trial.

Conclusion.

In concluding this first part of my report on Mathinna, I wish to emphasise my opinion that the goldfield has yet a long course of life before it. Its present unsatisfactory condition is mainly the result of two operating causes.

First, the large shoot of gold-bearing stone, which ha been worked so uninterruptedly in the New Golden Gat has become impoverished; and time has to be spent no in picking up the new shoot, which is almost certain t exist. Secondly, so many workings have been abandone at comparatively shallow depths without thoroughly pro ing the ground, that, strange to say, they act as a dete rent, instead of inciting to fresh work; and, moreove they tend to give the field a bad name. But confidenc in the field ought to be sustained by a knowledge of th fact that the gold occurrences are not mere sporadi instances, but are integral parts of the great series o gold-bearing channels which extend in this belt for s many miles north and south. That these channels hav been exhausted by the insignificant mine-openings mad into them here and there along the line is an absurd idea It may be regarded as a certainty that there still remain undiscovered an indefinite amount of gold in these reefs and this should help to dispel pessimistic views. I look upon the Mangana, Mathinna, and Mount Victoria field as forming a single geological unit. All three are indis putably charged with precipitated gold, derived, I believe from one and the same deeply-seated source; and, as gold fields, they possess, in my opinion, all the essential ele ments of permanence.

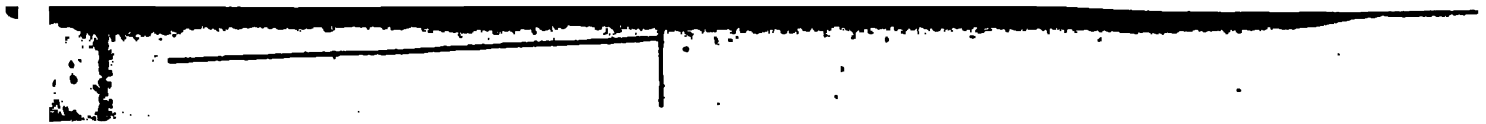
I beg to tender thanks to Messrs. H. J. Wise, T Andrews, T. J. Andrews, Jno. Campbell, Geo. Webb, Ben Searle, W. Stevens, Hitchock, and others on the field, fo information and assistance kindly given.

Part II. of this Report will be submitted at an early date.

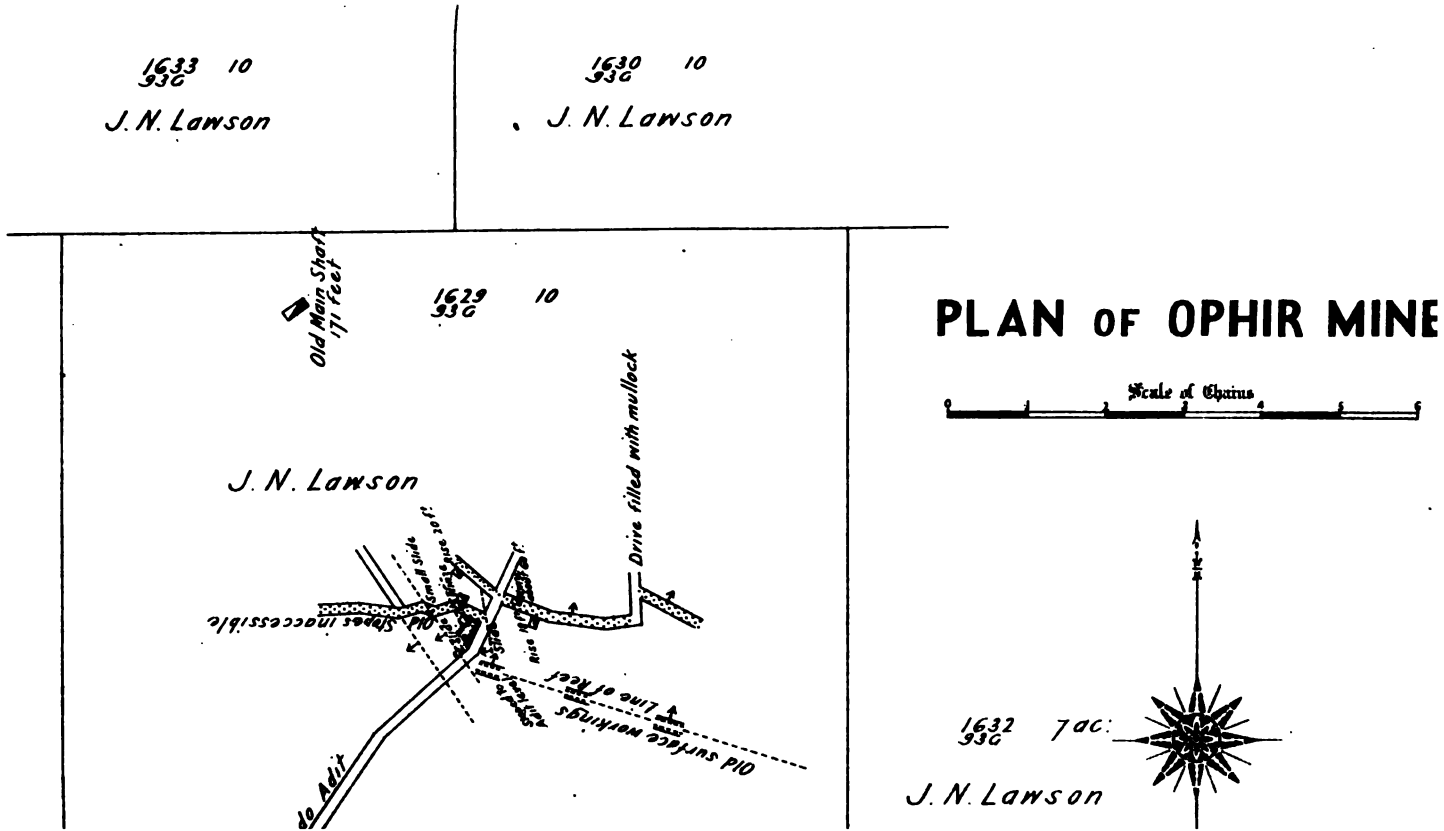
I have the honour to be,
Sir,
Your obedient Servant,

W. H. TWELVETREES.
Government Geologist

W. H. WALLACE, Esq.,
Secretary for Mines, Hobart.



PLAN OF OPHIR MINE



REPORT ON MATHINNA GOLD FIELD.

PART II

[With Two Plans.]

Government Geologist's Office,
Launceston, 27th August, 1906.

SIR,

I HAVE the honour to submit Part II. of my Report on the Mathinna Gold-field. Part I. dealt with the properties on the Gate line of reef, from the New Golden Gate northwards. I now proceed to notice those in the southern part of the field.

The same belt of reefing-country continues southwards through the sections 425-G, W. D. Stephens; 423-G, Stevens and Dick (Miner's Dream); 422-G, W. D. Stevens (South Miner's Dream—now A. J. Gabell); 426-G, G. Webb; 471-G, Volunteer Consolidated Extended; 419-93G, Telegraph; 409-93G, City; 322-G and 209-93G, Jubilee and Mountaineer. This is as far south as I have gone yet; but before I have finished with the field I expect to trace the line still further in that direction, as I find the strong axial fold of the country persistent through to the Jubilee; the strata north of the Jubilee Creek underlying east, and south of it underlying west. There is, therefore, a very good reason why reefs should be met with all along this line. The more I examine this zone the more astounded I am at the pessimism of those who look upon it as exhausted. This line, running north and south for 20 miles, denotes a persistence of gold quartz to great depths, and stamps the districts through which it passes as permanent gold-fields for generations to come.

The Hill ridge, south of the South Gate shaft, follows a direction east of south, falling into a saddle south of the mine, and then rising past the Pride of Mathinna shaft and, further on, the old Telegraph shaft. In the saddle at the race the slates are vertical, and fall away east and west from this line towards the Long Gully on the one side, and Black Horse Gully on the other. The first mine met with on this line is—

The Miner's Dream.

This is on Section 423-G, 12 acres, in the name of W. G. Stevens and D. Dick. Three chains south of the

north boundary, and 2½ chains east of the west boundary, is the old Pride of Mathinna shaft, which was sunk 70 feet to intersect a small north-west reef trenched upon at surface. This was cut in a crosscut at 50 feet east from the shaft, dipping east, but no definite information about it is obtainable. It is said to have been only a foot wide where it was cut. It is a little too far west to be a continuation of either of the South Gate east reefs; on the other hand, it ought to have been intersected in the west crosscut from the South Gate shaft. A formation, or wall, is shown on the mine-plan in the west crosscut, at 107 feet west of shaft, about where the Pride of Mathinna vein would come in; but to connect the two is quite speculative.

The work preliminary to the discovery of the Miner's Dream reef consisted of loaming up the east side of the hill from the race. A little gold was always followed, and 9 feet west from the shaft on the west side of the hill the discovery was made which led to the present sink and drive being undertaken. This was towards the end of 1903, and in a few months' time the fortunate finders obtained 140 ozs. of gold, valued at £4 0s. 5d. per oz. The mine has been worked only on the scale of a working miner's claim, but the quality of the stone has been excellent. The quartz has been crushed at the Volunteer Consolidated Company's battery, and the output has been as follows: —

	Quartz crushed.	Gold obtained.
For quarter ending—	tons.	ozs. dwts.
31st March, 1904...	10	50 0
30th June, 1904	11	90 10
30th September, 1904	11	57 4
30th June, 1905	12	40 0
30th September, 1905	13	37 11
31st December, 1905	10	26 0

The discovery of this reef after the spot had been tramped over for years is another instance of how gold-bearing stone may exist anywhere just below the surface in this belt unsuspected and unworked.

A small vertical shaft has been sunk on the western slope of the hill for 20 feet; and then a rather flat reef has been followed down for 150 feet on the underlay, bringing the present end to 100 feet below the surface, which is as far as it can be extended with the present system of working. The average underlay of the reef is about 27° from the horizontal, though at the end it has

become a little steeper. The width or thickness of the stone has varied from 1 foot to 2 feet. The mean direction of the drive is S. 50° E. No crosscuts have been put in from the drive, and, accordingly, very little knowledge of the reef is ascertainable. We do not even know at what angle to the strike the drive has gone in on. If at right angles, the reef ought to outcrop just east of the Pride of Mathinna shaft, and would be too far east to be cut in the crosscut from that shaft. From the indications, however, it seems more probable that the real strike of the reef is a few degrees west of north, and that the drive has been taken obliquely across it. But in this case it ought to have been seen in the old shaft. We shall not learn anything definite until more work has been done. The reef-quartz is white with rusty stains, and carries a little mineral, and the veinstone has been followed all along the floor of the drive. In the face it is growing steeper, as if it might change into a vertical vein, and the slate strata are dipping north-east. To continue work in this mine a new shaft further east and higher up the hill will have to be sunk, which is warranted by the good returns obtained from the stone. The work has now grown beyond the resources of working miners. The mine is situate in the Gate reefing-belt, and deserves to be proved in a serious way. It is quite possible that the flat lode may prove to be a feeder of, or dropper from, a more important reef. On the other hand, it may be that it is quite independent of any vertical reef, and in that case it will be rather difficult to work. This, however, can only be settled by further work, and as the vein has been such a good gold-producer, it ought to have a thorough trial.

About 40 feet south of the shaft a small shaft has been sunk to 35 feet, and intersected a flat gold-bearing vein, which was not payable at that point. This is probably the same as the main lode. In a pit a little further south a reef was cut about 18 inches wide, striking east into the hill, with a southerly outlay. A ton of the stone was crushed with the richer stuff from the other workings, and it was estimated to be worth 15 dwts. per ton. This will be found to intersect the flat reef in the hill, and there is a chance of something being found at the junction.

South Miner's Dream.

South and adjoining the Miner's Dream is the South Miner's Dream, a 10-acre section hitherto held by W. D. Stevens (422-o), but now held by Mr. A. J. Gabell.

An attempt has been made to intersect the Miner's Dream reef, about 500 feet further south, by driving a tunnel from the Long Gully side of the hill. The tunnel has been started 40 feet above the New Golden Gate Company's race in the abandoned section (439-G), and driven 380 feet in the direction S. 55° W. into the hill, through slate underlying east.

At 158 feet in, a reef formation about 2 feet wide was passed through, consisting of broken slate and three or four bands of quartz, from 2 inches to 7 inches in width, the whole underlying east, at an angle of 70°. It is said to be just gold-bearing.

One hundred and fifty-four feet further in is another reef formation, 2½ feet wide, carrying 7 inches of white quartz, also carrying gold, but even less than the first reef.

Seventy feet further is the end. The adit has just been driven far enough to reach the line of the Miner's Dream workings, but it must not be forgotten that those workings will plunge below the level of this adit. The only chance which it seems to me that the adit has, and it is a fair one, is of cutting some reef in the heart of the hill. Judging from the quantity of loose quartz lying on the surface of the ground ahead of the adit face, there ought to be some undiscovered reef between here and the crest of the hill. In addition to this, the position is excellent, being in the centre of the reefing-belt.

Volunteer Consolidated Extended.

This company owns two sections south of the South Miner's Dream, viz., 426-G (8 acres), in the name of G. Webb; and 471-G (10 acres), charted in the name of the company. The work is being carried on upon the latter section. This mine is situate up the Black Horse Gully, about 180 feet above Mathinna. Mr. J. Turner found gold here, and was joined by Mr. Webb and another, but they did not succeed in picking up the reef; and when the company suspended operations on its leases west of the township, it took this claim in hand.

The upper workings comprise an adit driven into the hill north-east for 60 feet, 45 feet of which have been across what appears to be a fault-fissure formation, consisting of rubbly clay, slate and lumps and arched bands of quartzite, mixed with a little vein-quartz. The adit has been driven right across this into slate. At 16 feet in the drive, a crosscut has been put in N. 38° W. for

17 feet in the course of the formation, which dips north-easterly into the hill; an opposite direction to that of the enclosing slates, which dip south-westerly. From a winze inside the entrance, and 12 feet below the adit, a crosscut was driven for 17 feet south-east, but this is inaccessible. In driving the above adit 23 tons of dirt were crushed at the Volunteer battery, and returned 6 dwts. 18 grs. gold per ton. The width of this formation in the adit is 45 feet. The prevalence of quartzite, and the small quantity of purely vein-quartz, are remarkable. The reason is most likely to be that a bed of sandstone alternated here with the slate. It has been shattered, in all probability, by faulting, and permeated by silica from veins carrying gold.

At the entrance of the adit an underlay shaft has been sunk for 50 feet. At 6 feet from surface the rubble formation was lost, and slate entered. Twelve feet from the bottom of the shaft a small vein, 3 inches wide, of quartz and quartzite was struck, which has expanded from 10 inches to a foot in width, and has been followed south-east for 60 feet on the northern wall of the drive. A little behind the end the stone is a foot wide, but does not carry gold there. At intervals in the drive, it is being bored through with a view of ascertaining its value. The reef does not come away easily from the country; and at my last visit I found it had pinched in the end of the drive, though it still appears to continue. A short crosscut has been put in behind the end, but will have to go a little further to intersect the formation.

At 20 feet from the shaft crosscuts have been driven—one, 29 feet north-east; the other, 28 feet south-west. At a few feet in the south-west crosscut the same rubbly formation is met with as was cut in the upper level, but here it is not more than 12 feet wide. It rises in a peculiar manner to 10 feet above the roof, and is then covered by solid slate rock. The veins in it are flat. A little slate underlies it at the entrance to the crosscut, and slate overlies it in the end. The covering of slate may be explained by irregularity of wall of the formation-channel causing overhanging projections of the enclosing slate. Near the entrance to this crosscut is a 5-in. band of quartz, said to be gold-bearing, underlying the formation and separated from it by a little slate. In the end of the crosscut is slate, with normal dip to the south-west. Although the soft formation closes in over the roof of the drive, I believe it is continuous with the channel intersected in the upper adit.

In the north-east crosscut, which is through slate, dipping south-west, at about 10 feet a little gold-bearing stone was met with in the sole of the drive. In the end a small quartz formation is showing.

The small vein followed in the main drive has been very persistent, but it is of subordinate importance to the fault-formation, though proportionately richer in gold. The veinstone is for the most part quartzite or sericitised sandstone (wall-rock), veined with a little pure vitreous quartz. The most feasible method of development will be to follow it into the hill, and crosscut west at intervals through the parallel formation until the latter begins to carry solid stone. If this is unsuccessful, sinking will have to be resorted to, for all the gold in the crush-dirt of the formation has certainly come from lode action somewhere in this channel.

A shaft a little higher up the hill is necessary to test this reef-channel at a proper depth.

The formation and vein strike in the direction of the old Telegraph shaft higher up the hill. They are probably parallel to that reef, and this indicates the existence on the property of a zone of reefs running N.W.—S.E., which should be traversed in depth by crosscuts from a main shaft.

This zone is west of the Gate zone.

Telegraph Mine.

About 500 feet south of the Volunteer Consolidated Extended boundary is the old Telegraph shaft, which was sunk 55 feet on a quartz vein 12 to 18 inches wide, running N.W.—S.E. An adit was started to come under the shaft from the east side of the hill, and is said to have passed through unimportant veinlets of quartz, but nothing solid and defined. Work was suspended fifteen years ago, but the continuation of the adit would be good work, as it would prove the hill at a rather favourable point; for the quantity of quartz lying about at surface is considerable, and points to the existence of a yet undiscovered reef. Less than 300 feet more driving is required to bring the adit end under the old shaft.

City Mine.

In the south-west corner of Section 400-93G are the workings of the old City P.A. A tunnel was driven east from the west boundary of the section for about 120 feet, and at 50 feet a wide mullocky formation was struck,

carrying quartz and pyrites. This was driven through for 25 feet, and appeared to strike a few degrees west of north, with an easterly dip. The width of this channel, and its position, have suggested the idea that it may be identical with one of those met with in the east crosscut in the South Gate Mine. The distance between the two is nearly half a mile, and the bearings are not quite the same, but we undoubtedly have here a prolongation of the same reefing-line. The more important matter, however, is to settle the relations of this reef with that of the Jubilee Mine, which is not far to the south.

A small shaft has been sunk at 60 or 70 feet above the adit, but I have no information about it.

Jubilee Mine.

This property comprises four sections—322, 323, 324-G, and 209-93G; in all, 40 acres. It was originally known as the Derby. The Derby Company opened up the mine on the Sections 209 and 322, which are on the Gate axial line, and three-quarters of a mile south of that mine. A good length of reef was worked—about 300 feet on the Derby reef, and nearly 200 feet on the Flat reef. A main shaft (the Derby shaft) was sunk 150 feet, and a crosscut driven to the reef, and some distance south on it, which carried gold at that point, but not enough to be payable. The reef had been stoped up to the surface from creek-level and 40 feet below, with good results. The average yield from the two reefs is reported as having been 1 oz. per ton. Operations were suspended in 1881. The Jubilee Gold Mining Company took over the mine in 1887, and did a little work on the Flat reef, which gave them stone averaging 9 to 10 dwts. per ton. This Flat reef is one which is situated a little farther to the north, but slightly to the east of the main reef, and has at one time connected with the latter at a higher level. This connection has been denuded, and the two are now quite separate. Two tunnels were driven on the Flat reef, and the stone stoped out between them and to surface.

In 1896 the Tasmanian Exploration Company Limited, took over the leases; and in 1897 cleaned out the main shaft to 168 feet, and cut it down and timbered it to the 160-feet level. Sinking was resumed, and the shaft deepened to 272 feet by May in the same year. The mine survey shows that the crosscut south-west from the main shaft intersected the reef at the 160-feet level, at 98 feet

from shaft. From reports which have been kindly placed at my disposal by Mr. H. J. Wise, I gather that the reef at that point was strong, and 3 feet in width. In the drive south the width of the reef decreased to 2 feet, carrying 18 inches of solid mineralised stone, and at 150 feet from crosscut was only 6 inches wide. Driving was discontinued at 177 feet. A winze was sunk for 42 feet from this level below the old stopes overhead; but it only showed clean slate, with a small seam of pug on footwall.

The north drive at this level was on a reef 2 to 3 feet wide, but poor; and at 68 feet it showed only 6 inches of stone on footwall side. A large quantity of stone had been taken out previously over the drive and near the surface, and it was thought that the drive would enter payable ground. A slide, however, displaced the stone; and the same displacement was met with in a winze from the floor of this level.

The main crosscut was driven to 318 feet from the shaft through slate, which, at 160 feet, changed from green to dark blue, of a very favourable character. At 188 feet, bunches of quartz were passed through, letting out a good deal of water; and at 200 feet numerous mineralised quartz leaders were intersected. This quartz zone continued for a width of 70 feet, when clean slate country was again driven in to a distance of 318 feet from the main shaft.

The main crosscut was also driven north-east from the shaft for 38 feet through hard slate with bands of quartz, when, from the plan, a reef-formation would appear to have been struck and driven on north. Where intersected it was 18 inches wide, and well defined. In driving north it widened to 3½ feet, between two good hard walls, carrying highly-mineralised stone 2 feet wide, but of poor quality. It was eventually reported as small, and tight for driving.

260-*feet Level.*—At this level crosscuts have been driven from the main shaft 183 feet south-west, and 38 feet north-east.

On starting the south-west crosscut 4 feet of quartz spurs were driven through, and at 85 feet quartz veins were again passed through for 2 feet. At 112 feet a channel was struck carrying 3 feet of stone, and a drive south was put in on its course for 140 feet. The reef soon fell off in width, and degenerated into bunches of quartz, and eventually to a small leader. All through this drive the stone was of poor quality. The western exten-

sion of the main crosscut passed through slate country, dipping south-west.

No. 1 Tunnel.—An adit was driven in the early days north of the present workings in a north-easterly direction for 70 feet; and as the recent Company, in stripping the main shaft, passed through a quartz formation at 20 feet from the surface (striking north and dipping east), it was decided to extend the adit with a view of proving whether this formation was connected with the gold-bearing stone previously worked. The extension was driven to 100 feet, through slate with mineralised quartz leaders.

No. 2 Tunnel.—120 feet further north is a parallel tunnel, which has been driven 217 feet into the hill. At 90 feet in is an old drive south, connecting the two adits, and at 120 feet beyond this a drive north-west was put in on the course of the reef for 50 feet. This reef was, where struck, a strong body of quartz full width of the drive, carrying a good deal of iron pyrites, galena, and a little gold. At 30 feet in the drive the quartz was still wide, but poor, and the lode walls were irregular and broken. At 47 feet a big body of stone was reported as still in the face, but its full size is not known, as the hanging-wall was not carried. A small winze was started in this drive, but passed through the reef not far below the floor or level.

The adit was continued north-east in slate, with numerous mineralised quartz leaders; and at 200 feet a hard wall was struck, dipping east about 2 in 6, and carrying 3 inches of soft flucan and 6 inches of highly-mineralised stone. This was driven on 16 feet north, the formation being gold-bearing 2 feet wide, and showing 8 inches of stone. It becoming small and somewhat broken, a drive was started on it south-east, and continued for 30 feet. The reef carried a little loose gold, and varied from 6 inches to 2 feet in width. As it showed signs of strengthening underfoot, a winze was begun on the gold-bearing stone passed through in driving the adit. Here it was solid, fully 4 feet wide, but of rather poor quality. At 20 feet down, the main hanging-wall was struck, underlying east 1 in 6. The formation at that point was 2 feet of dark slate and quartz, and the hanging-wall portion carried a little gold. At 45 feet down the reef was small, but more defined.

The work done from the old tunnel on the south side of the creek is inaccessible, and I can only refer to Mr. Montgomery's report. The ground has been stoped from the back of the tunnel near creek-level to surface for a

length of 140 feet, and north of the tunnel for about 40 feet down from surface for a length of 190 feet. At the end of the tunnel, which has been driven 216 feet in a south-easterly direction, a branch reef comes in, known as Stevens' reef, which was reported as carrying 18 inches of stone. It appears to have been driven upon 32 feet north-west.

Inspection of the plan shows where work in this mine might be usefully resumed. The 260-feet level is so far to the south-west that it involves a change in the underlay of the reef, which, however, seems well established as being to the north-east. The inference to be drawn is that the reef-channel has been passed through in the crosscut unnoticed, and that the reef at that level has not been proved at all. The bunchy quartz followed was probably mere country quartz. It would seem to be good policy to examine the crosscut carefully, and pick up the true reef-channel for driving.

The parallel reef east of the shaft has been driven on very little. It appears to have been well defined, and carrying promising quantities of pyrites. The mere fact of it diminishing in size when work was suspended should not prevent further work on it. I am credibly informed that, in general, it was an encouraging lode, and considered likely to make stone at any time. There is now a level at 260 feet, and this reef might well be proved at that depth.

It will be gathered that I do not consider that the property has yet had an exhaustive trial, and it would be a pity not to test it thoroughly, after obtaining such good yields from the upper part of the reef.

As for the Flat reef, such reefs are always difficult to work, and are often more important for what they lead to than for what they are in themselves. A good deal of quartz has been crushed from it, and it is probably connected with a reef of the normal character; perhaps with the eastern reef.

Between the City tunnel and the North Jubilee workings encouraging loams have been got on the side of the hill. I understand that at the north end of the old surface-workings 35 ozs. of gold were obtained from 30 tons of stuff. There is no doubt that the property is a seat of lode action. It is to be noted that in the western part of the workings the country underlies south-west, as is also seen at surface, while near the main shaft the underlay is towards the north-east. This, and the general

position, show that the mine is on the Gate axial fold. This circumstance has weight with me in considering the likelihood of gold existing in depth. The probabilities are neither more nor less than those for the Mathinna field proper, and if there are reasons for believing that field worth working seriously, the same reasons hold good here also.

Mountaineer.

South-east from the Jubilee, and between 200 and 300 feet up the steep hill which rises from the south side of the creek, are old workings, respecting which I was unable to obtain information. Some shafts have been sunk and adits driven, in one of which I noticed the stone was 12 to 16 inches wide. The reefs worked have a north-west strike, and a north-east underlay. It is the continuation of the Mathinna belt; and though there may not be much to induce expenditure on the hill flank, reef-channels will undoubtedly persist in depth, and it will probably be found here, as elsewhere in this district, that deep mining is the only class that will pay.

This is the farthest south to which I have as yet traced the Gate axial line. To the west of this line there is another reefing-belt, in which the reef-fractures take a more westerly direction, while the strikes of the strata and the cleavage planes remain generally the same.

This is an intermediate zone, between that of the Gate and the City of Hobart, and comprises, at the southern end of the field (which is the portion examined so far), the reefs of the Gladstone hill, the Eldorado, and the Victorian Golden Gate. The most southerly property is the--

Gladstone.

Section 1033-87G (10 *acres*).—This section is on the steep slope of the high hill south of the Eldorado, and the old workings were on a reef parallel to that one. The strike is N. 70° W., and the underlay to west of south. The reef is about 2 feet wide, and crosses the country slate, which bears N. 20° W., and dips south-west. The old timbered shaft, 6 feet 6 inches by 4 feet, is filled with water. To the west, the reef has been worked down from surface to 15 or 20 feet for a distance of a chain, and nearer the shaft to 30 or 40 feet. Mr. Guy took a crushing from this of about 10 tons, which, he says, averaged 12 dwts. The old crushings are said to have been 60 tons, worth 9 to 11 dwts. gold per ton. I am informed

that this was amongst the earliest reefs opened upon at Mathinna. The distribution of gold in it, however, was found to be irregular. It is situate a good way up on the north fall of the spur, which is separated by a deep ravine from the Eldorado property.

For 300 feet east of this is a series of trenches and shallow shafts on other reefs. The most easterly shaft was put down a couple of years ago on a reef coursing N. 55° E., and is stated to have given a small crushing of rich stone. The average width of quartz is 4 to 6 inches. A couple of chains further west a shaft has been sunk on a 6-feet formation of country slate, with bands of vitreous quartz, not well exposed. Between this and the old main shaft the ground has been trenched at one or two points, but as it is near the crest of the spur, not much backs are available.

About 300 feet up the hill to the south-west is a reef-line running N. 50° W., underlying south-west, and carrying a foot of strong white quartz, said to be of low grade. Mr. Stevens opened a cut upon it between two and three years ago, and other openings have been made further west, but nothing very rich has been found so far. The reef continues right through the section. Oxidised veinlets traverse the stone, and the gold probably has its source in these, for no mineral is visible in the quartz.

About 2½ chains west from the preceding, and higher up the hill, T. Parker has opened upon a parallel reef striking N. 25° W., and dipping south-west. The stone has much the same character as that of the other reef, but fair prospects of gold are obtainable. The quartz is about a foot wide.

Near the above is Guy's reef, with a foot of quartz exposed in the cut. The reef is said to be 2½ feet wide, and some good gold was found at one spot, but not picked up again. The strike is N. 55° W., and dip south-west. It is here 400 feet above the road, and just south-west is the hill summit. The reef crosses the spur, and would have to be worked from lower down. Unfortunately, it dips into the hill, and the spur is not very wide.

Further along towards the north-west corner Mr. Clarke has trenched up the hill from the gully on the boundary. Loose stone was found, and good gold prospects obtained. Further south some solid quartz was met with, but poor.

The whole of the hillside is strewn with quartz, and a lot of superficial prospecting has been carried on. Gold

has been found in several places, but it has given out, and men have continued work only as far as they could get down with the pick.

Most of the reefs course north of west and south of east, and this strike would take them into the Volunteer Consolidated Extended and Telegraph sections, on the eastern side of Black Horse Gully. They are not wide at surface, but they are numerous, and superficially have shown short shoots of gold frequent enough to suggest that deeper exploratory work might result in something a good deal better than has been found hitherto.

Ophir (formerly North and New Eldorado Mines).

Sections 1629-93G (New Eldorado), 1630-93G, 1631-93G, 1632-93G, 1633-93G, 1652-93G (North Eldorado)—in all, 52 acres; charted in the name of J. N. Lawson.

The principal works are situated on 1629 and 1652, nearly three-quarters of a mile south of the Mathinna township. The old work done from the former main shaft and from the upper tunnel was examined by Mr. Montgomery, and described by him in 1892.

The present company has done a little work from the old upper drive, prospected at surface in different parts of the property, and sunk a new main shaft to a depth of 121 feet in the north-west corner of Section 1652. The idea seems to have been to sink here to some depth and crosscut east and west, perhaps more particularly east, to intersect the supposed faulted part of the New Golden Gate reef south of the crosscourse in that mine. The policy is sound, provided the reef in question has really been faulted, for its heave, according to all the rules of faulting, should be to the west of the Gate drives. But I have shown in my previous report that there is reason to doubt whether faulting has actually taken place, and the exploratory crosscut west from the 1200-feet level has not come across the missing part of the reef, though it has been advanced to within 90 feet of the western boundary of the 3-acres section. That is to say, the crosscut has reached a line which, if produced southwards into the Ophir section, would be about the same distance, viz., 90 feet east of the Ophir new main shaft. This zone of 90 feet accordingly represents a distance which has not been proved, and in which the lost reef could occur if, as said above, it has been displaced by a fault. To set this question at rest, the shaft might be deepened another 100 or 150 feet, and the crosscut east driven at that

depth. I do not think that it is necessary to sink deeper than that for this purpose before opening out, for at this depth the country rock will be found perfectly solid and favourable for reefs.

The shaft, however, is in a position for proving, by means of a crosscut at any depth that may be determined upon, the formations which were intersected by the old North Eldorado adit, 3 chains to the east. The old underlay shaft, 170 feet north of the new shaft, is said to have been sunk 110 feet on a reef running N.W.—S.E., about 18 inches wide, and a few tons of quartz crushed. The adit was driven to prove this reef, and has been put in 400 feet in a south-westerly direction. The first formation of any note that was passed through is a quartz vein 18 inches wide, dipping north-east at 70°. This was also cut towards the bottom of the new shaft, where it yielded a few colours of gold. Past the intersection in the adit quartz is occasionally seen in lumps and patches associated with flat arches of quartzite. Bunchy quartz in a belt of sandstone 3½ feet wide would appear to represent the reef sunk on by the old 110-feet shaft; at least, according to its position, but the two are dipping in opposite directions. At 30 feet behind the end of the adit a winze has been sunk 34 feet, where there is a quartz formation about 1 foot wide; and in the end, another quartz and quartzite formation, dipping flat to to the west, is visible. The quartz all through this adit is barren, so the gold-bearing stone taken out of the 110-feet shaft must have been a short shoot. The line of the winze reef is about 200 feet south-west of the new shaft, and as it is underlying into the hill, the deeper the shaft is sunk the further the crosscut will have to be driven. The same applies to the reef at the 110-feet shaft. A crosscut of about 500 feet from the new shaft, in a south-west direction, would prove all ground between the shaft and the new Eldorado adit, but it should be looked upon as purely speculative and prospecting work.

New Eldorado (*Section* 1629).—The old work done on this has been described in detail by Mr. Montgomery, and there is no necessity for me to go over the ground covered by his report. The surface workings in the centre of the section show that a reef half a foot to 2 feet in width runs in a direction 20° south of east, and has been stoped down to varying depths, the maximum being over 50 feet. The stone is said to have yielded

from 18 dwts. to 1 oz. of gold per ton, and some of it nearly 4 ozs. per ton. The old drive east is now unsafe, and the stopes above are inaccessible. An underlay winze has been recently sunk from this drive to a depth of 42 feet on quartz which yields prospects of gold, but not payable. A little free gold is noticeable. In the drive above this winze, onwards for 50 feet, the quartz has been found gold-bearing, and the work has connected with the old workings on the surface. The main adit, continued further south for 20 feet, passes through what has been regarded as the other part of the reef, which has been followed for a couple of hundred feet west. The channel is 4 to 5 feet wide, filled with clay and soft rock. A winze sunk near the beginning of the drive went down 60 feet, carrying a couple of inches of stone on the south wall. A little west of this a rise has been put up 18 feet, but no stone stoped from it. A small vein of milky quartz has been followed in the drive, but it was not worth anything, though a nice bit of stone was met with now and then. A flat lode crosses the drive from north to south, dipping east at right angles to the southerly dip of the main reef. It has been driven upon south, but the drive is filled with mullock. At the west end of the main level the vein is small and tight, carrying a little gold, but practically of no value. A crosscut north from this level might have disclosed better stone, but nothing permanent can be expected without proving at greater depth. The disturbances in consequence of slides will make work rather difficult and uncertain. A little work has been done by a short drive east, but very little stone was met with. A main shaft was sunk in the south-east part of this section to a depth of 171 feet, and a crosscut begun at the 163-feet level to intersect the reef at somewhat more than 100 feet below the levels just described. I could not learn in which direction this crosscut had been driven, but the best direction for avoiding the disturbed ground and reaching the reef quickly would be due north.

New Eldorado (*Section* 1630).—On this section, 120 feet north of the south boundary, is an old underlay shaft (Whip shaft), sunk to 113 feet, from which, I undertsand, three short drives were put in on a reef about a foot wide. Mr. Montgomery reports 77 tons as being taken from this shaft, and yielding 105 ozs. of gold. The reef runs about east and west, and dips to the south.

The works are inaccessible now, but the good stone found in the old days makes it likely that there is something here which is worth exploring. No solid stone is seen, and probably the reef consisted of bands or leaders in comparatively soft slate. Some recent trenching to the east disclosed a little gold in the softened slate. The ground in this part of the section is traversed by several outcropping veins, which have been tested by Mr. Hitchcock, the mine manager; but as the result in each case is about the same, I need not particularise. Some long outcrops have been sunk or trenched upon, and have occasionally given gold prospects, but when followed down a little the quartz is replaced by clean country.

Section 1632.—This section is traversed by more than one line of reefs, running north-west. One such line passes out of the section, at its north-west corner; another passes south-east down below the Whip shaft. These lode-lines are characterised by short shoots of quartz with variable gold contents. The country is slate, with thin beds of sandstone, often sericitised, striking N. 30° W., and dipping south-west. A good deal of trenching and superficial work has been done on these lines, and the quartz, rather white and free from sulphides, should be favourable for specimen gold. Its occurrence is so irregular at and near the surface that up to the present shallow work has been unsuccessful. Either something more definite will have to be located or hopes must be fixed on deep exploration.

During the past year the Ophir sections have been diligently prospected by Mr. Hitchcock without coming upon anything which promises to be permanent. The work offering most result appears to be the deepening of the new main shaft, and exploring from it into the hill. We are here in a different zone of reefing-country from that of the Gate line. The reefs run much more west of north, and seem to be subsidiary to the main north and south reef-lines of the district, filling fractures which, as it were, connect the parallel north and south main zones. This makes any prediction hazardous, but it is probable that the good stone formerly met with at comparatively shallow levels will be replaced in depth by a more permanent make, provided that the troublesome faults can be avoided. The chance of meeting with a faulted part of the Gate reef is slender; but, apart from that, the property offers facilities and fair prospects for deeper exploratory work.

Victorian Golden Gate.

This property comprises Section 527-G (10 acres), in the name of S. J. Plain, and Section 349G (10 acres), in the names of G. T. Gibson and J. F. O'Kelly, and is situate about 50 chains south of the Mathinna township.

The recent work is in the southern part of Section 527-G, where, at the bottom of the hill, west of the Eldorado, a crosscut has been driven north-east across grey slates, which dip south-west. At 222 feet in, a reef has been intersected, which appears to run, roughly, in a south-easterly direction. It was followed for 30 feet, and then sunk on by an underlay-winze for 30 feet; but in the drive east of the winze it has been lost, and not recovered, though the level was continued for 200 feet further. The continuation, however, has pursued a north-east direction, which is hopelessly wrong, being nearly at right angles to the observed course of the reef. The position of the workings is not favourable for shallow drives, as the reef will pass under the gully just ahead, but backs can be obtained once the gully is passed. I could learn nothing about results from the quartz taken from the reef. The first thing necessary to be done at this mine is to find the continuation of the reef. It must also be made clear whether it has been displaced by a fault or left by the altered course of the drive. The reef would appear to bear into the Ophir Section 1632. Judging from general experience on this field, exploration by adit is not favourable for permanent work, the large reefs being developed at considerable depths. The poor and disordered character of the reefs disclosed by adits not far from surface inevitably brings driving to a standstill; and if no capital is provided for the difficulties of deeper work, mines are abandoned, and it is not easy to get them re-started, even when there is fair warant for doing so. This hillside gives evidence of reefs existing, from which a certain amount of stone has been taken, and below the zone of superficial disturbance more solid quartz may be expected to prevail.

In the eastern part of 527-G is a belt of reefing-country 5 or 6 chains wide, which has been prospected by means of numerous trenches and shafts. The stone outcropping is a white, glassy, yellow-stained quartz, generally in light-coloured sericitised sandstone, in bands alternating with slate. O'Kelly's reef, in this belt, has a direction of N. 40° W., and consists of a quartz vein in a small band of sandstone, in slate, in a vertical position. A

little gold has been got in it. This mixture of quartz and sandstone is known locally by the name of "native cat.' There are parallel runs of such reefs east of the track up the hill, from which gold has been got in the course of prospecting. These reefs are generally a foot or 15 inches wide.

Some very old workings exist on the western side of the hill down the fall to the tunnel, and a rich patch of gold is said to have been struck at one time.

Section 1154-93G (10 *acres*).

This is a vacant section, formerly in the name of T. C. Goodall, when the name of the mine works was the Golden Gate Hinges, otherwise West Gate. The adit is situate 30 chains south of Mathinna, east of the track up Black Horse Gully, and has been driven N. 49° E. into the Golden Gate ridge for 168 feet. At 20 feet in, a rubbly formation of twisted pyritous graphitic slate, with flat veins and blows of quartz, begins, and continues to the end. At 108 feet in, are a shallow winze and short drive to the north-west. Near the winze, the slate, which elsewhere in the drive has an underlay to the north-east, dips west. The easterly dip of the strata on this side of the hill is only seen elsewhere where the track enters Mathinna, nearly opposite the old post office.

Martyn's Section, 451-G (18 *acres*).

This is in the name of Alex. Forbes Martyn, on the east fall of the City of Hobart hill range, half a mile south-west of Mathinna. At about 60 feet above the valley two shafts have been sunk, 150 feet apart. The north shaft has been sunk 72 feet; and at 60 feet a crosscut was driven east through reef-formation, with and carrying a little gold. The bearing is stated to be bands of quartz, said to be 9 inches wide, well mineralised, north-west, and uncertainty exists as to whether this is the same reef as is seen at the outcrop, or whether there is here a junction of two reefs. The shaft was begun about ten years ago, and good prospects were obtained. It went down for 50 feet on the wall of the reef, nearly vertically, and the latter then went right out of the shaft to the east. The strata also dip east in the crosscut. At 100 feet north of the shaft the reef has been exposed in a trench, 15 feet lower down the hill. Mr. Martyn tells me that the gold is finely disseminated

through the stone, no coarse gold being seen. It is his intention to deepen the shaft another 100 feet; a wise policy as far as it goes, but it should be sunk still deeper. Southwards the reef outcrop has been trenched across at intervals, and the south shaft sunk 8 feet east of it to a depth of 50 feet, and then intersected the reef, which consists there of blue quartz, said to be 8 feet wide. The stone is hard, vughy, mottled, blue quartz. Mr. Martyn sampled it in 2-feet sections, and says that on the footwall the assay yield reached 5 dwts. per ton. An old upper crosscut at 25 feet also intersected the reef for 6 feet. Both reef and country at surface dip west, but in descending, become vertical, and then change their underlay to an easterly direction. The reef has been prospected for 130 feet south of this shaft by trenches. The stone, where exposed, is rather flinty-looking, and has given some fair prospects. Endeavours have been made to discover stone higher up the hill to the west, but without success.

The reef is about 3 chains west of the road. It must obviously be a parallel one to that of the City of Hobart. The latter ought to pass through the section from north to south higher up the hill. Notwithstanding the local variableness of the dip of the strata, the general underlay in this belt of country is still in a westerly direction. But we enter here another reefing zone, that of the City of Hobart line, roughly parallel to the Gate line, with which it is connected by the north-west reefs system, already described in this report.

City of Hobart Mine.

Three sections are charted in the name of the City of Hobart Gold Mine, Limited, viz.:—472-G (10 acres), 520-G (10 acres), 521-G (10 acres). The main workings, however, are on the 20-acre Section 618, in the name of the Commercial Bank; and two sections (223-83, 5 acres; and 94-93G, 10 acres) are still held by the Tasmanian Exploration Company, Limited.

The properties are idle, and the workings inaccessible. I can, therefore, only form an opinion from information received, and by examining the indications supplied by the work done from the surface.

The old main shaft (now fallen in) is on Section 618, a quarter of a mile south-west of Mathinna. The first work was carried on some thirty years ago by adit, a crosscut tunnel striking the reef, 4 feet wide, at

50 feet from surface. This was then driven upon for 500 feet, much of it proving mullocky; but Mr. A. A. Butler reported that the quartz obtained from 120 feet of reef was crushed, and averaged 1 oz. of gold per ton. The main shaft was sunk 660 feet, and according to Mr. Peter Irvine, who was the mine manager from 1877 to 1881, the reef carried about 3 feet of loose quartz, worth over 1 oz. of gold per ton, down to a depth of 300 feet. At 580 feet a slide displaced the reef west and north. The reef where the shaft was sunk has a north and south bearing, and is nearly vertical, or with a slight dip to the east. At a depth it is stated to have changed its underlay to the west. Though the stone was good the shoot of gold was short. An expensive system of 60-feet levels was followed, and shaft-sinking continued without accompanying driving on the course of the lode. The slide was met with, and the company became discouraged, though if, as I am credibly informed, £80,000 worth of gold was obtained, there was certainly ample warrant for continuing work. In a southerly direction, about 150 feet from the main shaft, a small prospecting shaft (City Extended) has picked up a vein 6 inches wide, carrying gold; and 200 feet further south, just inside the north boundary of 521-G, is another shaft, supposed to have struck gold-bearing stone. There are several runs of veins in this zone, and it is difficult to connect the different workings satisfactorily; but the surface-trenching would indicate that the northern shaft is on a continuing vein of the main reef.

In the north-western part of Section 618 are several old shafts and trenches on a lode apparently running north and south along the western boundary, and known as the North City of Hobart reef. The deepest shaft was 180 feet deep. The reef-channel seems to be a couple of feet wide, and has been worked at surface for some distance along its course. Reports state that it is a low-grade reef, averaging only 2 or 3 dwts. per ton. Its bearing is east and north, and it dips east, a parallel reef evidently to the main reef; there being a distance of about 3 chains between the two, if each maintains its course. A little to the east of this line a new main shaft has been sunk recently, but work was suspended when it reached a depth of 100 feet, and I do not know whether the reef was struck. In cutting the engine-plat a reef was exposed, prospects from which, I am told, went 3 dwts. of gold. Not long ago Mr. T. Andrews cut the excavation

for a new shaft, 130 feet west of the old main shaft, with a view of working the main reef from it. The idea was to drive south beyond the old workings, prove the reef upon which the property was floated, and test the junction of three distinct reef-chanels in that direction. The position of the proposed shaft seems favourable for these objects, and it enjoys the advantage of being in solid ground.

In the south corner of this section are the old Champion shafts on more than one reef. The principal reef, which is reported to have yielded 7 dwts. per ton, strikes a little south of north-west, and dips south-west, if continuous, it must intersect the City main reef.

The North City and the Main reef are both reefs that require prospecting, especially the latter, which has yielded so much gold-bearing stone of good quality. Mr. Irvine has stated that below 300 feet the white friable quartz is replaced by blue laminated quartz, heavily charged with auriferous arsenical pyrites. It would seem, therefore, that a good plan for the owners is not to attempt restoring the old main shaft, but to pick up the main reef from a new shaft well out of the influence of the old workings, and open out on it at a moderate depth. Each of the sites which have been contemplated, viz., that of the new shaft already begun, and that prepared by Mr. T. Andrews, has advantages of its own, according to the aim in view.

It is singular that what may be called an ounce proposition has remained idle for so long. The neglect to keep exploratory work well ahead while production and sinking were going on was undoubtedly responsible for the despair which settled down on the proprietors after they had picked the eyes out of the mine, and which eventuated in the abandonment of a property which had promised so well. The consequence is, the exploratory work remains to be carried out. Though nothing certain can be predicted there is good reason for expecting that judicious development expenditure would be well repaid. The lode junctions, which must take place at some points, the converging directions of several of the veins, even the narrowness of many of them, indicate a system of fractures which will possibly, in more than one place, unite to form larger bodies of stone, accompanied by concentrations of gold, which past work has shown the reef to hold. This is really all that can be said at pre-

sent. The zone is indisputably gold-bearing, but search for the shoots cannot be properly undertaken without the outlay of considerable capital.

Alluvial Flats.

In both the Black Horse and Long Gullies there is a good deal of alluvial, which has been washed down by the main crecks and their tributaries. As these creek-courses intersect reef-lines, besides receiving the sheddings from auriferous reef outcrops on the hill flanks, a good deal of gold must have found its way into the valleys. Thirty-five years ago a considerable number of men were engaged in working the ground, which, I am informed, has never been what may be called rich. Considering the number of gold-bearing reefs in the surrounding hills this might be thought inexplicable, if we did not take note of the fact that the gullies are comparatively recent in origin. They have been formed while the country has been assuming its present configuration, and consequently there has not been time for any large concentrations of gold to accumulate. The best part of the alluvial field has been that at the mouth of the Black Horse Gully, east of the township, where the deposit averages from 6 to 7 feet in depth. Higher up the gully the depth increases to between 10 and 30 feet, finally shallowing to a few feet. It would seem, therefore, that some bar of bedrock crosses the valley lower down, damming the alluvial to some extent. The lead on this line has been turned over at intervals for 1¾ miles for a width of about 400 feet. In the early days small nuggets up to 4 or 5 dwts. were common, and I am informed that once a piece was found weighing 1 oz. 19 dwts. The gold is always well waterworn. Mr. W. Stevens tells me that he found the alluvial east of the Golden Stairs yielding 3 grs. to the dish.

For a long time it has been thought that the cradling operations of former days did not exclude the possibility of the deposit being payable if treated by the modern method of hydraulic sluicing. Mr. Leslie Jolly has recently endeavoured to ascertain the value of the ground, and some extensive boring was carried out by Mr. Geo. Webb, of Mathinna. Eighty-seven holes were put down, a chain apart, in 10 lines; the lines being 8 to 10 chains apart.

Mr. Jolly has kindly furnished me with the results of these: —

		Average depth.	Gold per cubic yard
		ft. in.	grains.
1st line	7 holes	7 4	0·43
2nd „	10 „	7 6	2·58
3rd „	13 „	5 0	5·904
4th „	8 „	5 5	6·43
5th „	10 „	7 6	22·80
6th „	11 „	7 0	11·88
7th „	10 „	6 2	13·881
8th „	8 „	7 4	10·101
9th „	5 „	6 1	24·384
10th „	5 „	6 11	26·782

Average yield, ½ dwt. gold per cubic yard.

The deposit consists of about 3 feet of clay and small drift, covering quartz-wash mixed with clay, and the whole lying on a layer of pipe-clay, which covers the bedrock. I was informed that the gold is found on and in the pipe-clay.

General information is to the effect that sufficient water for hydraulic sluicing can be brought in from the Tyne with 100 feet of pressure; and the report furnished to Mr. Jolly is to the effect that the total cost of recovering the gold would not exceed 3d. per cubic yard, or say, equal to 1½ grains of gold. The ground is certainly shallow, but there is a total absence of boulders and tree stumps.

The valley of the South Esk must certainly hold a good deal of gold in the aggregate, brought down by that river and Dan's Rivulet, and all the lateral tributaries. It is, however, a broad valley, and the gold will no doubt be found considerably scattered. The best alluvial is nearest to the present river. I understand that boring was carried on at Marshall's some years ago, and that as much as half a dwt. per dish has been obtained there. Some desultory hole-sinking has been done here and there in the alluvial of this plain, but without result. If the South Esk alluvial could be systematically prospected, there is a fair chance of some discovery of payable ground, for there must be places where concentration has taken place. For ages quartz gravel and any accompanying gold have been carried down from the Mathinna and South Mount Victoria fields, and deposited in the Esk Valley. I suppose that everywhere over this rather broad plain a little gold can be found; but it is

also extremely likely that definite channels of concentration exist somewhere as yet undiscovered.

Conclusion.

In concluding this part of my report, I realise more than ever that the intermittent and half-hearted way in which so many of these properties have been worked has been very disadvantageous to the interests of the field. A little money has been raised, and when it has been spent, and the gold-shoot worked out or faulted, operations have been suspended, and the reputation of the field suffers in consequence. The sooner it is recognised that it is neither a poor man's nor a poor company's field, the better. The rewards will only fall to the lot of those who persevere in serious work. The New Golden Gate has been one prize; the other deep mine (The Tasmanian Consols) may be another. The undeveloped properties of the Jubilee and City of Hobart invite an outlay sufficient to really prove their value; and the owners should meet with no insuperable difficulty in procuring the necessary capital.

The Gladstone and Eldorado hills have really only been scratched. The Miner's Dream and Telegraph hill is almost virgin ground, and no one can say what it might develop into in depth. In fact, the part of the field covered by this report could be described in a sentence—"prospected but not developed." But there is no valid reason why work should not be resumed. Ordinary mining risks must, of course, be faced. Gold may not be met with at any given point, but that it exists, and in quantity too, in the reef-channels below this field, does not admit of any doubt whatever.

Part III. of my report on Mathinna will be prepared after a future visit.

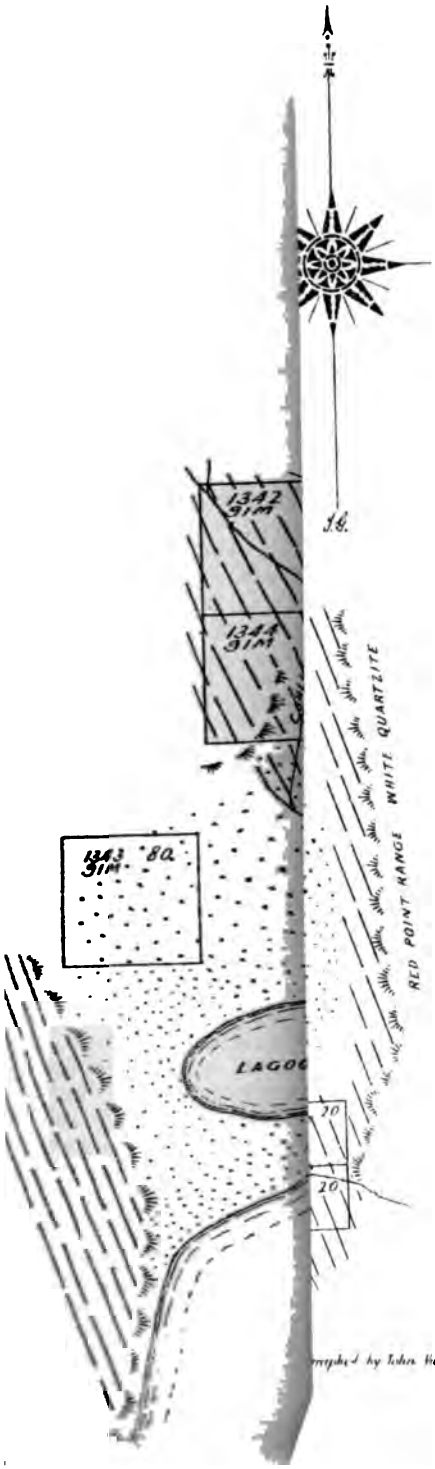
I have the honour to be,

Sir,

Your obedient Servant,

W. H. TWELVETREES.
Government Geologist.

W. H. Wallace, Esq.,
Secretary for Mines, Hobart.



REFERENCE.

Granite

Schist, and Quartzite, and Slate.

Alluvial.

Tertiary Alluvial.

W. H. Twelvetrees
Government Geologist
December 1906.

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REPORT ON COX'S BIGHT TINFIELD.

[With One Map.]

Government Geologist's Office,
Launceston, 5th December, 1906.

SIR,

I HAVE the honour to report that, as instructed by you, I proceeded to Cox's Bight on the 31st August, and returned to Hobart on the 18th of the next month. I was accompanied by Mr. M. J. Griffin, Inspector of Mines for the Northern and Southern Division.

The country bordering on the Bight is little known, and the land outside the mountain ranges, which hem in the little strip of flat country on the sea-shore, is practically *terra incognita*.

The Bight is a broad bay on the south coast of Tasmania, 6 miles across, divided into two smaller bays by a small promontory (Point Eric), which rises to a conical summit, 160 feet above the surface of the water. The horn of the west bay is formed by the precipitous bluff range, known locally as Cox's Bluff (charted as New Harbour Bluff); that of the eastern bay is the hill range which terminates in what the fishermen call Red Point. The distance from South-West Cape is about 12 miles; and from Recherche, by water, 36 miles.

Between Catamaran, at Recherche, and the Bight the country is wholly uninhabited by man. In 1901 and 1902 Mr. T. B. Moore, under instructions from the Surveyor-General, cut and marked a track from Hastings to Cox's Bight, passing the western head of Port Davey, and his reports on same are published in the Surveyor-General's Annual Reports for 1900-1901 and 1901-1902. With reference to the Cox's Bight section of his track (between the mouth of the Old River and Point Eric), he says:—"Primary and eruptive rocks occupy the whole of this line of country. Silurian slates and schists, highly mineralised, occur in places along Bathurst Harbour, which are well worthy the attention of prospectors. At Cox's Bight a granite boss, about 1¼ mile in diameter, rises through the Silurian strata at the southern end of the

Bathurst Range. The creeks on the east and west side of this intrusive mass have been worked in a very primitive way for alluvial tin. If a good supply of water were stored, and the old workings sluiced in a systematic way, I estimate that a far greater quantity of ore would be won than that previously obtained."

Mr. Moore's observations on the mineral characteristics of the country between Hastings and Fort Davey are the only ones that have been published. It is known that as far as the New River, or the south end of the Arthur Range, the prevalent geological formations are Permo-Carboniferous sandstones and shales, and the eruptive trap-rock (diabase) of Mesozoic age. The western mineral country appears to come in at the New River, for Mr. Moore mentions limestone in that basin containing traces of copper pyrites, tetrahedrite, carbonate of copper, and galena. Thence westwards the country consists of slates, schists, and quartzites, which have been unprospected for mineral, but in which discoveries will very likely be made when the area is made accessible by the construction and maintenance of tracks. The mountain ranges preserve the usual north and south or north-west and south-east trend, terminating seawards, as a rule, in bold, lofty bluffs; and a track overland from Recherche, if anywhere near the sea, would have to reckon with these promontories. In March this year Messrs. Tyler and Harper were commissioned to go overland from Recherche to the Bight to find a route for a track. The way they went was as follows:—Cockle Creek, 2 miles past Recherche; across to South Cape, on to the beach; across Coal Mine Hill, past the old Government Huts; across South Cape Creek (by wading), up Fluted Cape (1600 feet); thence to Granite Bay and Shoemaker Point; thence to Surprise River (crossed at mouth by wading), and along beach to Tom Pretty's Point; from thence to the New River (crossed by raft); and thence to Deadman's Bay, and up the great High Bluff (3000 feet); west of this to the Louisa Plains and bay, separated from Cox's Bight by the dividing range of quartzite and schist. What time was occupied in cutting their way through to the Bight does not appear from the published account, but the return journey was made in five days, with one day's interruption by accidents and weather. They think that, with a boat at New River, a track could be made taking only three days to walk. It would seem certain, however, that a four-day track is possible.

Mr. T. B. Moore's track to Hastings is much longer, and crosses the high land at the heads of the rivers. This avoids the steep ascents of the bluffs near the sea, and secures a tolerably even grade; in fact, Mr. Moore says a railway grade can be obtained.

During my stay at the Bight we discussed the question of the route with Mr. Gaffney, and possibly might have returned overland if the weather had been better, and the old boat on the right side of the New River. For the purposes of the Bight, a track to Recherche is the one that is most needed, and although the country is rough, it has been shown that no insuperable difficulties exist. The men who are developing the resources of the State in such an isolated spot are entitled to a more certain and more easily available means of communication than is afforded by the little steamer which pays periodical visits. If the stores run out, or a conflagration takes place, or any serious accident happens during the absence of the steamer, the result may be disastrous. For such eventualities a track through to the nearest settlement is most desirable.

Between the Bight and the New River such a track would pass through schist-country, in which most probably mineral discoveries will be made. This south-west corner of the island has, owing to its inaccessibility, received no attention from prospectors. Much of it consists of barren-looking quartzite, very unpromising from a mineral point of view; but, on the other hand, granite and favourable-looking schist and slate belts exist, which it is difficult to believe are destitute of ore deposits.

Overland by Moore's track from the Bight it is not more than 7 or 8 miles to water, at the head of New Harbour Creek, which is an inlet of Big Bay, Bathurst Harbour; and if tin-mining here progresses, it may be the means of opening up the Port Davey district.

The high ranges round the Bight are partly bare, with their crests of white quartzite shining like snow, or lightly timbered on the spurs and heights, with heavy growths of myrtle, sassafras, gum, and fern in the ravines, which deeply score their sides.

The Bathurst Range rises to 2800 feet at the trigonometrical station, but a view of the latter is obscured by the nearer eminence of Foley's Pimple, the conical-looking end of a spur from the range, from which, in a series of saddles and prominences, a ridge descends to sea-level at Point Eric.

Geology.

The succession in the geological record at the Bight may be succinctly presented in tabular form, as under:—

RECENT.	Swamp and lagoon land at foot of terrace ground. This deposit descends to a few feet below sea-level. Terraces of tin-bearing detritus and wash at foot of mountains, from 50 feet to 150 feet above sea-level.
TERTIARY.	Terrace of clayey sand with carbonaceous material fringing foot of mountains 150 to 200 feet above sea-level.
JURA-TRIAS.	Not represented.
PERMO-CARBONIFEROUS.	Not represented.
DEVONIAN. (?)	Biotite granite below recent terraces and exposed in mountain form from sea-level up to 600 feet. Intrusive in quartzite and schist and intersected by veins carrying tin ore with accessory molybdenite. Dyke of hornblende-lamprophyre intrusive into quartzite found as loose stones on beach at east end of Western Bay. Veins of greisenised quartz intrusive into quartzite near junction of latter with granite. Actinolite contact-rock as loose stones on beach near Sand Bluff.
SILURIAN AND ORDOVICIAN.	Not identified.
PRE-CAMBRIAN.	Quartzite of Cox's Bluff Range, Foley's Pimple, Bathurst Range, Red Point Range. Mica schist and quartzite at Point Eric. Mica schist at Black Bluff.
ALGONKIAN.* (?)	Slate and sandstone on Slate Range. Silvery mica schist on fall of range to Louisa Bay.

* Proterozoic—of Chamberlin and Salisbury—Geology, Vol. II., pp. 163-217.

The schist and quartzite belong, apparently, to the geological series between the Cambrian and the eruptive Archæan, to which American geologists have applied the term Algonkian, dividing the Pre-Cambrians into an upper series (Algonkian), dominantly sedimentary, and a lower one (Archæan), dominantly eruptive. At the Bight the quartzites and mica schists alternate so rapidly, and are so intimately connected, that it is reasonable to attribute a sedimentary origin to both. The white saccharoidal quartzite is undeniably an altered sandstone, and the schists (muscovite, sericite, and biotite) were most probably alternating stratified argillaceous beds, now reconstructed and distorted beyond recognition.

The Bight is one of the localities in which have been found the objects known as obsidianites (= Australites of Suess), or obsidian buttons, now very generally regarded as of cosmic origin. Mr. Christopher Iles informed me that he discovered some at about 100 feet above sea-level, under 2 feet of button-grass peat and on the top of 3 feet of tin-wash, the latter resting on granite rock. A feature of interest connected with this find is that the wash is unmistakeably of recent (Quarternary) age. It adds another to the list of evidences pointing to the shower of meteorites being subsequent to the deposition of the Tertiary sediments in Tasmania.

Mr. Lark Macquarie, of Hobart, is said to have been the first discoverer of tin at the Bight, which he obtained from a hollow or basin in the south-east part of Section 1620, near the neck of Point Eric. After him came Robert Glover and W. H. Foley, from Port Davey. Reward sections on the western bay were granted to these in September, 1892, which were transferred to the Glover and Foley Proprietary in 1893. Messrs. Glover and Foley also worked on the eastern bay; and after them, one Meldon was at work, till Mr. J. J. Gaffney and the present company (Cox's Bight Tin Mines, N.L.) started work.

The information which I have been able to gather establishes the fact that from first to last about 120 tons of tin ore have been won from the ground at the Bight. In 1905 3 tons were shipped, and in 1906, up to the time of my visit, 4¼ tons had been consigned.

Several parties hold sections here. The Cox's Bight Tin Mines are working terrace-ground overlooking the eastern bay, at the foot of the granite and quartzite range. The same company holds three terrace sections on the

western bay, and two sections of alluvial flats bordering one of the lagoons on that bay.

Messrs. Weber, Gourlay, and Hawson are taking leases of lagoons and surrounding flat land on the same bay. Messrs. Pender and Atkins hold mountain sections, comprising the granite spur which has shed the ore into the lower ground on each side of it. They also have a section on Bourke's Creek, near the shore of East Bay. F. Pender has applied for a section west of the Black Point Range, and north and adjoining this is a section for which Mr. J. J. Gaffney is applicant. West of the latter H. Gaffney has applied for 80 acres.

From this it may be seen that the tin ore is spread over a fair extent of country, say about 3 miles from east to west, and from half a mile to a mile from north to south.

The observed granite contact with the quartzite spur of Foley's Peak runs east and west inside the north boundary of Pender and Atkins' section 1524-M, 80 acres, and continues east along the north boundary of A. D. Sligo, 1619-M, 20 acres, where it is exposed by the high-level race. To the north of this contact is the mountainous country of the back range, in which, so far, no granite has been seen. Inspector Griffin and Mr. J. J. Gaffney ascended the Bathurst Range to the trigonometrical station. From the summit an extensive view was obtained of Port Davey, the Arthur and Franklin ranges, and all the tumultous sea of mountain country lying north and east, and concealing, doubtless, in its unexplored fastnesses, mineral deposits, which at some future date will be dragged to light and pressed into the service of man. For the present, the camp at Cox's Bight is the advanced outpost of explorers.

Between 50 and 60 miles further north-west, near Moore's Look-out, north of the Junction Range, Mr. T. B. Moore noticed the occurrence of stones of tourmaline-bearing quartz, and bearing in mind the generally linear character of our granite exposures, it would not be surprising to find granite outcropping somewhere between these two points. Wherever it may be found on this line, I think it is highly probable that it will be found to be tin-bearing. This likelihood should be borne in mind by prospectors. Even where the granite does not crop out visibly it may possibly have risen to no great distance below the present surface, and sent out tin-bearing veins into the overlying or surrounding schists. Taking this into account, and also the copper and antimony ores which

have been found in the Port Davey District, it is possible that the south-western portion of the island may eventually rank as a substantial contributor to the mineral output of the State.

Cox's Bight Tin Mines, No Liability.

This company's operations are on the following sections (charted in the name of A. D. Sligo):—1290-M, 40 acres; 1291-M, 40 acres; 1292-M, 40 acres; 1619-M, 20 acres; 1620-M, 40 acres; 1613-M, 60 acres (now forfeited); 1614-M, 80 acres; 1612-M, 40 acres; 1796-M, 76 acres; 1797-M, 80 acres; and more land has been applied for north-east of the eastern sections.

At the time of my visit work was being carried on at two faces, Meldon's and Gaffney's, on sections 1292-M and 1620-M.

These faces are in a flat terrace of wash, from 40 to 150 feet above sea-level, composed largely of stones of quartz, quartzite, and granite, and up to 15 feet deep, the waste of the adjoining hills. Meldon's face is the upper one, and is about 3 chains in length, with 7 to 10 feet of wash, the lower 3 or 4 feet being the best. This face was worked in the old time by Glover and Foley; then by Meldon; then by Gaffney.

I was informed by Messrs. Gaffney and Heise that a measured 1200 cubic yards turned out 24 bags of ore in May last, which is equivalent to 2½ lbs. tin ore per cubic yard. Prospects washed by Inspector Griffin were equivalent to 5 lbs. per cubic yard. Four men are employed in this face, which is yielding about 1¼ tons per month. The bulk of the tin has always been got from this section, and it is still the best ground. It is at the foot of the granite spur, and was favourably situated for receiving the tin-drift from the mountain. The stone in this terrace-wash is heavy, interspersed with sand at intervals, in small quantity.

Owing to the quantity of stones the wash looks at the first glance unpromising, but its tin contents are undeniable, and it has always yielded more tin than it prospects.

The terrace being near the foot of the hills the stones are not so much waterworn as those which compose terraces nearer the coast. The tin ore is in fair-sized grains, generally black in colour, sometimes grey, and also resin-coloured. A nugget weighing 2 ozs. was shown to me. The largest which Mr. Gaffney has seen has weighed a quarter of a lb., but they have been reported as heavy as 7 or 8 lbs. Smoky quartz crystals have been observed, but no

gems; and tourmaline seems to be absent. A few specks of molybdenite were noticed by Inspector Griffin in a small quartz vein traversing the granite on the high spur.

The water for hydraulicing Meldon's face is brought from Bell's and Cox's Creek, in a race about a mile long. The length of column is 300 feet, and about 3 sluiceheads of water were being used, with a 2-inch nozzle. I understand that last year there was plenty of water, except for five weeks in the middle of summer, and that after rain 5 sluiceheads can be got. To pick up additional water it would be necessary to extend this high-level race (which is 230 feet above the brow of the face) nearly another mile, to Bourke's Creek, which would give twice the present quantity of water, and probably make up the total to sufficient for an uninterrupted supply all the year round.

Gaffney's face is in the terrace inside the north-east angle of section 1620-M. It is about 45 feet in length, with a bed of wash averaging 6 feet in depth. The face itself is 10 or 11 feet deep to the granite bedrock. At present the wash consists of large stones of quartzite, but sand occurs at times. This face is yielding fairly well, though the contents are not so rich as the upper one. It is served with water brought from the lower race, which has its intake on Luttrell's Creek.

East of this are faces near the brow of the terrace, facing the sea, between 40 and 50 feet above the swamp, now idle.

A. is a small face on the edge of the terrace; 2 chains north-east from it is B. face. C. face is 2 chains north of B. face. D. face is 1½ chains north-west of A. face. The terrace edge is 650 feet from the beach, and its level surface extends back for ½-mile to 1 mile to the foot of the mountains, covered with button-grass, which conceals from 5 to 18 feet of quartzite wash, resting, at any rate in its western part, on granite bedrock.

The section downwards in B. face is 10 feet of large wash, resting on a layer of carbonaceous matter, with decayed timber, below which are 5 feet of wash, lying on the granite. The upper 10 feet carry coarse tin (Messrs. Castle and Heise obtained over 7 lbs. to the cubic yard); the lower wash is poor and patchy. C. face has wash varying from 2 to 8 feet, with fair tin. In D. face the wash is tight—5 or 6 feet of large stones and feathers out to the south. Variable tin prospects have been got from this. Three holes have been put down further west in 6 or 7 feet of wash, with moderate to poor results. Inspector Griffin got good results from Meldon's

shaft. This flat button-grass terrace of wash extends all over Section 1290, and over half of 1291 and 1292. The eastern part of this area has not been prospected. The wash, which is exposed wherever the peaty covering has been removed, is nearly entirely quartzite towards the extreme east, and quartzite mixed with granite in the central and western part. The bedrock over the whole area is probably granite. It is undoubtedly granite on Section 1619, on 1292, and on 1291, where the bottom is exposed in the faces on the brow of the terrace. This fact largely increases the possible area of granite whence tin ore may be derived, adding considerably to the granite area exposed above surface. This flat terrace-land extends over, approximately, 80 acres, of which perhaps 50 acres has been ascertained by prospect-holes, &c., to be tin-bearing. Nothing definite appears to be known as to the character of the balance of the ground, but there is every reason to believe that it will be stanniferous, though being further from the mountain it may not carry such heavy tin as the wash near the foot of the hills.

The timbered gully coming down from the granite ridge west of the present main workings has yielded the best prospects on the whole field, and is in an ideal position for collecting the sheddings of tin ore from the ridge. The terraces west of the Main Creek are shallow, up to 3 feet of wash, but give good prospects, and offer every inducement for extending the high-level race, and dealing with them.

Information has been submitted to me showing that Mr. H. Castle and the company's manager, Mr. F. Heise, took 39 measured samples, within an area of 50 acres, from wash averaging 6½ feet deep, which gave an average return of 2 lbs. 3 ozs. tin ore per cubic yard. In addition to this, 1215 cubic yards on Meldon's face, 12 feet deep and 5 chains wide, gave 2 lbs. 3 ozs. per cubic yard.

Before beginning to sluice, the face was sampled for 1 lb. 5 ozs. per cubic yard, so the actual yield proved much better than anticipated. The samples above referred to went as high as 7 lbs. 5 ozs. per cubic yard, and as low as 4½ ozs. to the yard. Inspector Griffin got 2 ozs. to the dish, or 5 lbs. to the yard, from the upper face, so undoubtedly high values occur. The work of sampling the area so as to form an accurate calculation of the tin contents is not within the sphere of my duties, but putting together the results of my examination and the information supplied, I should be disposed to agree that the whole

50 acres might be estimated at between 1 and 2 lbs. per yard; perhaps fully the latter quantity for the part now being worked, and somewhat less for the eastern margin of the sections.

With the present price of tin, this ground should be highly payable, even taking into account somewhat higher working costs than ordinary, entailed by the remote position of the field and imperfect shipping facilities.

In addition to the upper terrace there is a lower flat of swamp land 2 or 3 yards above sea-level, on the southern half of the Section 1291-M, about 9 chains wide from north to south. Very little is known of its value for tin. Three holes have been sunk in it at the foot of the terrace; one was sunk to the granite bottom through 6 feet of peat and 7½ feet of wash-dirt, poor in tin. Mr. Gaffney sank another shaft through 7 feet of peat and 7 feet of wash, which carried a little tin all the way down. No. 3 hole was sunk to 16 feet in the line of the creek. I was told that wash was met with at 14 feet, but not payable.

One must be prepared for some difference in the contents of this swamp, as compared with the deposit in the higher terrace. The brow of the terrace evidently marks an old shore-line, and the swamp-ground has only been above sea-water during a comparatively recent period. It is now only 6 to 8 feet above high-water mark, which does not allow any great lapse of time for the accumulation of ore since it was raised above the waves. Before the elevation of the land the tin would tend to be scattered by the action of the waves, and the wash distributed over a somewhat wide area, and consequently not likely to be so rich in tin as the heavier wash, which has been accumulating on the terraces for a much longer time. It is possible, however, that in places a fair quantity of mineral may have collected. The flat cannot be prospected by hole-sinking, owing to water. Systematic trials by boring should be instituted, and the value of the ground ascertained; but it would also be well to consider whether this area is not too limited to warrant the expenditure required for equipping dredging-plant.

The company has not done anything to its sections on the western bay. Meldon's old workings are in the south-west corner of Section 1797-M, in a small narrow gully in the granite foot-hills. His tailrace runs down to the swamp on Section 1612-M. The wash is 6 feet deep, and consists of large stones of white mica, granite, and quartz, the latter predominating. I was told that 18 cwt.

of tin ore has been won from here. Glover's old workings are on the adjoining section to the west, 1614-M. A strip up the gully for 3 or 4 chains has been worked, and I understand 10 tons of tin-ore were obtained. The body of wash in the gully is 20 to 25 feet wide, and has been worked down to a depth of 8 to 10 feet, but not bottomed. It is composed of large stones and boulders of quartz, quartzite, and granite, and is altogether the largest deposit of heavy wash on the western sections. Nice prospects of coarse tin can be got here, some of the tin adhering to quartz. Below the false bottom Mr. H. Castle ascertained there are 5 feet of wash, prospecting 2 ozs. to the dish.

The granite is exposed in the banks of this creek; to the west of it the quartzites come in. The granite hills come down to Meldon's and Glover's workings, and then, with the exception of a low knob of granite protruding through the swamp 5 or 6 chains north of the small lagoon, the bedrock to the south all over Sections 1612-M and 1796-M is concealed below an alluvial plain or swamp.

About 100 yards below Glover's workings a hole has been put down in the plain, 10 feet deep, without bottoming. The drift showed a little tin.

Irregular prospects, some good, some poor, were obtained from 2 shafts, 16 feet and 17 feet, on this plain. No bottom was reached, owing to water.

In Section 1613-M, further west, a hole was sunk 12 feet, but no tin obtained; and I believe no granite has been found on that section. The section appears to be well within the quartzite area.

A granite bottom most probably underlies in Section 1796-M, and a part of the adjoining one to the west. A portion of a small lagoon lies within the boundaries of these two sections. This flat, swampy land can only be dealt with satisfactorily by dredging, prior to which it must be well prospected with boring rods. The whole of the granite waste from the western side of the dividing spur has been shed into this low ground, which is only a very few feet above sea-level, and it would be very surprising if tin were not found. While the distribution of the ore may be rather widely spread, there are probably special channels in the drift which could be located by boring. The good results obtained on the higher ground by Glover and Meldon indicate that much tin must have found its way into the flat.

Work on the two upper sections will have to be by sluicing. Whether the creeks can give a continuous

adequate supply of water is doubtful. The supply, however, could be supplemented by pumping from the lagoon.

Looking at this company's property, as a whole, there is no doubt that the decision to start on the eastern sections has been a wise one, for a fair area of payable ground is being worked, and a considerable extent of promising ground is ready for testing. As regards landing plant, this is not impossible in favourable weather if a landing-terrace is cut in the sea-wall at Point Eric, and hoisting machinery used; but the sea is very uncertain, and the weather would have to be watched. Tin ore in bags is at present carried to the steamer by boat through the surf. If operations are carried on here on a large scale, doubtless in course of time Bathurst Harbour will be utilised.

Kent Tin Prospecting Association.

This association has been formed to develop 370 acres on the west bay, viz., four 80 and two 25-acre sections, applied for in the names of Messrs. Weber, Gourlay, and Hawson. Two lagoons are situate on the property within a very few feet of sea-level. The western, or large lagoon, extends for the length of two 80-acre sections as far west as the range of Cox's Bluff, which closes in the bay in that direction. The land all round these lagoons is a swampy button-grass flat, separated from the sea-beach by a few chains of dune-sand, covered with thick ti-tree scrub, which forms a kind of bar, damming back the fresh water of the swamps. A creek, however, issues from the lagoon, and flows into the sea.

This large flat receives the drainage of the high ground on the north and north-east. Every creek which comes down from the hills carries tin, and must have been shedding ore slowly into this shallow basin for ages. The terrace-ground on this side of the dividing range runs a little farther back from the sea than on the eastern bay, and the swampy area is therefore larger. The flats in the neighbourhood of the lagoons have not been bottomed on account of water, which consequently prevents sampling before boring rods are on the spot. Prospects taken haphazard from the unbottomed drift are valueless. Below the surface peat a white sand-drift appears to prevail, and a little fine tin has been obtained from prospects. It was in another part of this large stretch of flat, swampy ground that two holes were sunk by Mr. Gaffney and the company to 16 and 17 feet without bottoming, but yielding tin from

¼ oz. to 2½ ozs. per dish, so that the swamp has been definitely shown to have formed a reservoir or collecting-place for ore, which was only to be expected in view of its position.

This flat ground occupies all the area which the Kent Syndicate intends to hold, and on it is a part of the small lagoon, and the whole of the large lagoon, mentioned above. The depth of the latter has not been ascertained, but Mr. Weber judges that there are from 6 to 8 feet of water in it. Some fine tin has been found in creek sand further west, at the base of the Cox's Bluff Range. This has either been derived from veins in the quartzite, of which that range is composed, or is the remnant from a larger deposit of drift covering the plain in old times.

The plain, certainly, has been below the sea in recent time, geologically, and the tin is probably distributed through the area pretty widely, though the extreme western portion is likely to be the poorer part, being most distant from the granite hills.

In the hilly quartzite country, north of the Kent ground, are the abandoned Conliffe's Creek sections, extending a couple of miles inland to the headwaters of that creek. That area is all quartzite, and it is not probable that much tin will be found in it.

The first thing for the Kent P.A. to do is to prove its ground by boring, as there is too much water for shaft-sinking. Wherever shaft-sinking is possible, shafts should be sunk. Although more costly than boring, yet with them there is much less chance of being misled; but owing to the water the boring rods will be necessary in most cases in this flat. The whole of the contents of the bores must be carefully gauged in a measured box, and the tin weighed, and great care expended on the entire operation, as it will form the basis of all calculations. Tubed bore-holes, 1 chain apart (or a less distance whenever a channel is found to exist), in every direction would test the ground very thoroughly. Towards the western end bore-holes at each 100 feet would suffice. The depth is unknown, but I should think that it would be somewhere between 20 and 40 feet at most. With the results from these bores the owners would be in a position to calculate the value per yard to a nicety. This preliminary work is absolutely necessary prior to placing machinery on the property.

The bottom of the deposit is probably at sea-level, or below it, and the conditions require elevation of material and water. This, and the frequent removal of plant,

indicate the adoption of hydraulic dredging, if the water difficulty can be overcome.

Landing and shipping in the western bay can only be effected from the beach, but the property is only distant 7 or 8 miles from Port Davey waters.

Pender and Atkins' Sections.

These are 1534M, 80 acres; 1525M, 40 acres; 1526M, 40 acres; 1527M, 40 acres (on the west bay); and 1735M, 80 acres on the east bay

Of the above, the 80-acre section is, perhaps, the most important, as it is nearly entirely composed of granite, and contains the spur traversed by the quartz veins which have shed most of the tin ore into the adjoining properties.

The spur or ridge rises from the sea in a succession of rocky knobs to a height of 600 feet, when the granite junctions with the quartzite inside the northern boundary of the section. At the junction, white mica appears in the veins of quartz, which are partly greisenised.

At about 800 feet above sea-level, west of the north-west corner of the section greisenised quartz veins occur in quartzite, and in this neighbourhood a white quartz reef in quartzite country 2 feet in width, barren and massive, courses N. 45° W. to the west boundary of the section. Still higher up, on Section 1525, is a large reef of quartz, with a north-east strike, and further west another broad outcrop of white quartz, with a north-west strike, traverses the same country rock.

These reefs in quartzite and the greisenised veins in the same country rock are important, as showing that lodes have passed from granite into the surrounding country. Such may explain some of the occurrences that have been noted in this field, of alluvial tin in creeks flowing over quartzite and schist country Heavy tin has undoubtedly been shed from Pender and Atkins' sections into the properties on either side of the ridge, and it seems that this tin has been derived mainly, if not entirely, from veins, and not from the granite matrix itself.

The characteristic mica is magnesian, and there are no stock-works or extensive alterations of the granite in the form of stanniferous formations; but the quantity of tin found in the wash at the foot of the hills points to the existence of rich veins as yet undiscovered. The southern part of Section 1524-M descends to the alluvial ground near the sea on the western bay, which may have received a fair quantity of tin ore from the range.

Unfortunately, there is the difficulty of absence of water, which probably could be remedied by pumping supplies from the lagoons if all the sections were in the same hands.

The Sections 1527-M and 1526-M would appear to have been taken up mainly for position, as the granite is exposed only along their south boundaries. It is possible, however, that greisen veins in the quartzite may be tin-bearing. The sections have not been explored. They occupy the high hilly ground at the back of the Cox's Bight Tin Mines sections, and search might be made along the southern boundaries for tin veins at or near the granite junction, especially as the gullies coming down from them carry tin.

There is a mineral lease, 1735-M, 80 acres, on the east bay, in the name of F. Pender and C. Atkins, on which a little work has been done. The southern part of this is flat, swampy ground, a part of the low alluvial plain mentioned on the Cox's Bight Tin Mines section. This ground has not been bottomed, and will probably be found to carry fine tin. It is from 8 to 10 chains in width. and is only 2 or 3 yards above sea-level. The extent of this ground on the section is, however, limited. To the north of the creek is a hill range composed of quartzite and slate, with a strike a little west of north, dipping south-west. On the crest, brown slate is observed, crossed by east and west veins of barren quartz. Large quantities of white quartz stones are scattered over the surface of this hill. At the summit is also a vein of white vitreous-looking quartz, 1 foot wide, crossing the country east and west in soft brown laminated and jointed sandstone. This rock may possibly be a softened quartzite. At any rate, it belongs to the same series as the quartzites and schists. Further east is a parallel lode of white jointed quartz, striking N. 80° W., without any trace of mineral. This hilly ground deserves prospecting for copper lodes. The quartz, which is strewn about everywhere, has not a very favourable aspect, but mineral may eventually be found in some of the veins.

Section 2559-M, 80 *acres—F. Pender, Applicant.*

This is north-east of the preceding, and is situate in the foot-hills between the quartzite and slate range on the west, and the Black Point schist range on the east.

On this section, too, there is a lot of loose quartz scattered about. Beyond a little prospecting, no work seems to have been done, but I was told that some tin

prospects had been got out. In the south-east angle, east of the creek, a strong east and west quartz reef is marked out by a line of loose quartz. The stone is white, and mineral is not visible in it.

Section 2455-M, 80 *acres—J. J. Gaffney, Applicant.*

This is on the same hill ranges as the section to the south, 2559-M, and shows similar quartz detritus. It is a section which invites prospecting for lodes in the same way as F. Pender's.

Gourlay and Tolman's Creeks Claims.

This ground, situate north of the preceding, is watered by Gourlay's, Tolman's, and Bourke's creeks. These join and form a large creek, eventually flowing through Pender and Atkins' section, further south. Some prospecting has been done on it by Mr. Weber.

The works on Tolman's Creek show excavations down to about 6 feet, exposing 3 feet of turf, 9 inches of small tin-bearing wash, and 2 feet of heavy wash, resting on soft, brown, and bleached slate. The strike of the country here is N. 50° W., with dip to the west. A little tin has been won. This is on Mr. Weber's prospecting area. Better ore is obtained higher up the creek, where the wash, consisting of angular quartz and slate debris gives good prospects. The observed strike of the slate was N. 20° W., and dip, as usual, to west.

Bourke's Creek, a little further east, is too full of boulders and large stones to be worked, consequently Tolman's may be said to be the most easterly creek that has been worked, though, as mentioned above, tin has been found on Section 2559, and even as far east as the base of the Red Point Range.

There are two ways in which the presence of tin on the slate and quartzite bedrock in this part of the field may be accounted for. Some of it may be directly derived from veins which have penetrated the country rock, and some have survived from a former (Tertiary) covering of drift, vestiges of which still remain to the west of these creeks in the form of a high terrace clinging to the base of the mountain.

Section 2456-M, 80 *acres—H. Gaffney and Jones, Applicants.*

The ground on this section west of the Big Creek was worked by Tolman. Heavy quartzite wash exists

for 8 feet below the peaty grass surface, but it has not been bottomed. The wash consists of flat, rolled stones, mixed with sand, and has been worked for a width of some 15 feet, and 60 feet in length. Near the edge of the workings is a 10-feet hole, also not bottomed, showing stones of quartzite all through.

In the northern and north-western portion of this section is a terrace of sandy clay raised to about 200 feet above sea-level, and some 40 feet above the other terrace-ground.

A creek east of Luttrell's Creek has cut down into this drift, which gives prospects of fine and coarse tin. The drift is a soft brown deposit, with a little carbonaceous matter in it, and is apparently a terrace of Tertiary age. From this we learn that the uplift of the shore-line shown by the lower terrace has not been the only one which has taken place here. Mr. Gaffney sank a shaft 15 feet in this deposit while I was at the Bight, and obtained a few prospects of tin, but when the boring rods are on the property a few holes should be put down on this terrace, for there may be runs of tin in it which would pay to work. Sinking holes at haphazard would be of no use, as valuable gutters might easily be missed. There are some possibilities here, as this fringing terrace is distinct in age from that of the granite terrace lower down. Luttrell's creek, to the west of this, is a narrow creek, with steep banks, and must have cut its channel in soft material, possibly the same Tertiary deposit. The ground between here and the Cox's Bight T.M. properties further west, is the lower-terrace ground, covered with quartzite detritus. It has not been prospected, and little is known of its capabilities. It should receive whatever tin is shed from veins in the quartzite range.

Black Point.

The mica schist range terminates on the sea-coast as a precipitous bluff, running north and south. Tin is said to have been found on this range on the vacant 56-acre section, 1371-91M, and again, further north, to the east of Section 2455-M. At the bluff itself, on the sea-front, there is a pyritic quartz vein in the schist a few inches in width. Some of the pyrites is arsenical. An assay of the stone by Mr. W. F. Ward, the Government Analyst, yielded the following result:—Gold, trace; silver, 8 dwts. per ton.

This, and the slate range to the west, would appear to be more favourable for the discovery of silver or copper veins than the harder quartzites, but prospecting has been

so limited that the potentialities of these mountains can hardly be gauged at present.

Further south-east are the two old gold Reward sections, granted to Messrs. Brakespeare and Brice, but indications of mineral upon them are not known.

Conclusion.

Reviewing the district as a whole, there is no doubt that its present value is due to the output of tin ore, which is proceeding steadily on a limited scale. With respect to this mineral, the field is not likely ever to be one of more than moderate dimensions, as the exposure of granite is not large. The extent of terrace-ground fringing the base of the mountains is known and easily measured, and the area of lagoon and swamp ground is clearly defined. The nature of these areas has been outlined in this report. The sections taken up by the various associations cover, approximately, the tin-bearing ground at the Bight, so that we have there a compact proposition parcelled out among a few owners, some of whom, with proper management and adequate capital, will probably find their venture payable. The Cox's Bight Tin Mines Company ought certainly to do so, for the extensive tests made in different parts of the area by Messrs. Castle and Heise indicate a valuable property. The Kent Tin P.A. has not yet proved its property sufficiently to enable a forecast to be made.

Meanwhile much interest attaches to the work going on there, for success means the extension of exploration northwards and eastwards into practically virgin mineral country. If granite is found further north, tin will most probably accompany it; but irrespective of granite exposures, the ancient schists of this part of the island are likely depositories of copper and antimony ores, and from the scattered indications which have been found hitherto it is possible that when the country is better known discoveries of value will be made.

I have the honour to be,
Sir,
Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

W. H. Wallace, Esq.,
Secretary for Mines, Hobart.

REPORT ON THE RENISON BELL TINFIELD.

Government Geologist's Office,
Launceston, 18th December, 1906.

SIR,

I HAVE the honour to submit the report of a brief visit to the Renison Bell Tin Mine, in accordance with your instructions, on the 23rd to 27th of last month. The present report will not extend beyond a preliminary statement of the geological and mining problems met with at the northern or Renison Bell end of the Dundas tin-bearing belt, leaving a more extended report on the whole belt till a further visit to the district is made.

Deposits of tin ore occur in the North-East Dundas district, within a zone of country roughly estimated at about a mile in width, and coursing in a persistent line from N.W. to S.E. for about 3 miles in length.

Though some of the lodes strike north and south, or to the east of north, their bearing for the most part is north-westerly, which is the direction of the cleavage planes of the country rock.

This linear direction of the metalliferous belt must not be ignored. The lode occurrences have not been haphazard, but have been in obedience to some orderly physical process, which not only serves to indicate the directions in which prospecting may be carried on usefully, but also very strongly suggests that a good deal about the ore occurrences remains to be learned.

Acid eruptives being the true source of tin, the origin of the Dundas tin deposits may quite naturally be ascribed to neighbouring granite. Examination of the various lodes of this part of the West Coast leads irresistibly to the belief that underlying granite is responsible for much of the ore-deposition which has taken place. Most of the country rock at the northern end of the belt under review is slate or crystalline sandstone, or quartzite, the geological age of which has not been defined precisely, but it is nearly certain that it is Lower Silurian or Ordovician. Prof. T. S. Hall, of Melbourne, has identified some graptolites in slates from the North-East Dundas Railway, near the Ring River, and also at 12½ miles from Zeehan on the

same railway line, but he pronounced the discovery of no great value for determining the age of the containing rocks. We have, however, good reason to believe that the Dundas series of stratified rocks are older than those at Zeehan, which are known to belong to the Upper and Middle Silurian.

In various parts of the North-East Dundas district the sedimentaries are penetrated by basic eruptives, such as gabbro and serpentinised olivine and pyroxene rock, *e.g.*, on the Penzance and Goldstraw's sections. With these basics may be connected concentrations of copper, lead, nickel, and iridosmine, as regards the former epigenetically, and the latter by a magmatic process, but tin-deposition evidently took place subsequently to their consolidation, and accompanied the intrusion of tourmaline quartz-porphyry dykes. These dykes have pierced both the serpentinous rocks and the sedimentary strata, but tin has not been found, and is not likely to be found, in the former, for this metal appears all over the world to be associated genetically with only acid eruptives (granitic plutonics or their geological equivalents).

My attention during this visit was confined to the country immediately contiguous to the Renison Bell Mine, and I first endeavoured to learn all that could be ascertained about the occurrence of igneous rocks in the neighbourhood.

Isaacson's Creek is a small creek which rises in a vacant section north of 1215-M, C. Brumby, and flows for a mile north-easterly by the side of the Emu Bay railway line, eventually emptying into the Ring River. Mr. Gilham took me to this creek, the sand of which gave prospects of gold, tin, and iridosmine (osmiridium). I was informed that about ½-dwt. or 1 dwt. of the latter mineral is present in each cwt. of tin ore from the creek. The chocolate-coloured slate on the banks of the creek shows a development of serpentine (sometimes slightly asbestiform) in the joint or cleavage planes, and it is highly probable that serpentine rock exists somewhere in the hill situate to the south-east. In the creek bed I also saw a greenish granitoid rock, the precise nature of which needs microscopical identification; but it was not fully exposed, and I could not say positively whether it is *in situ* or not. Search for granite should be made in the hill above this creek.

Lower down the Argent River, north-west of the Renison Bell, and also on the line of McKimmie's tramway

towards the Tasmanian Smelting Company's lease, serpentine is also reported to be present. From the latter direction Mr. Gilham brought to me some stones of granitoid rock found by him in prospecting. All this shows that the northern end of the metalliferous line connected with the eruptive rocks has not yet been seen.

At 140 feet from the south-west angle of the Renison Bell Section 2536, Porphyry Creek crosses the boundary line. Its bed is quartz-porphyry, containing scattered needles of tourmaline, a little iron pyrites, and fluor stains. The apparent direction of this quartz-porphyry dyke is north-westerly, consequently parallel to the general trend of the lode-belt. Going south-easterly a similar rock outcrops on the boundary line between Section 165-93M and Section 1963-M, 1000 feet above the railway line, intrusive into slate. The distances between the exposures are so great that I could not satisfy myself whether this is the same dyke or not. Tourmaline quartz-porphyry and tourmalinized slates are intimately associated with tin ore deposits in other parts of the district, and consequently it is not surprising that the tin lodes on the Renison Bell ground should be accompanied by this intrusion. It would appear that the dyke forms an intrusion extending along the western side of the tin-bearing belt all through that ground. At the same time, it is not the only occurrence of quartz-porphyry in the district. I noticed a small quartz-porphyry dyke 3 feet wide in the centre of a 50-feet pyritic formation in the south-east angle of Section 1342-M, 75 acres, in the name of J. Craze, which was discovered a few weeks ago. The formation with the dyke has a bearing N. 35° W. Further south on the Penzance and Goldstraw's sections there is a good deal of quartz tourmaline porphyry, and there can be little doubt that its intrusion all through was an integral part of the process which introduced the tin into this area.

A further indication of the granitic source of the tin present in this district is in the well-known vein of axinite in the Cornwall (New Dalcouth) and Commonwealth sections. The question whether this vein has faulted the lode there or has been the channel of mineralisation is of interest, and even of some importance, to the owners. Different views exist, but in the short time at my disposal I was unable to arrive at any definite opinion in the matter. It seemed to me, however, that the direction in which the ore-body should be developed is along the line of lode, notwithstanding that the bearing of the axinite

vein corresponds more with the general trend of the other lode outcrops in this belt. I could not, however, investigate the whole of the data bearing on this point.

I have been informed that as far as can be ascertained fully 200 tons of tin ore have been sent out from the North-East Dundas district during the last fifteen years from alluvial and detrital deposits. In some parts of the field much of the ore has been found as large nuggets, 7 lbs. to 14 lbs. in weight; sometimes boulders of pure tin ore a hundredweight each have been met with in sluicing, and one large boulder weighing nearly a ton of ore is in the Tasmanian Museum, Hobart. These boulders indicate the existence of rich tin veins up to a couple of feet or more in width.

The tin is invariably in the form of oxide (cassiterite), but apart from that found in connection with quartz-porphyry, it is in the majority of instances associated with sulphidic gangues (pyrite, arsenopyrite, or pyrrhotite). It is this that has probably mainly contributed to the stagnation of lode-mining in this field. The treatment of ore stuff from which pure oxide of tin, as on the East Coast, can be easily removed is so simple and inexpensive that the separation of tin stone from these contaminating sulphides has been a bogey which has frightened adventurers.

The exact metallurgical treatment cannot be settled offhand, but there is no inherent difficulty about it (comparable, say, with the zinciferous sulphides of Mt. Read, &c.). Mr. J. D. Millen of the Mt. Bischoff Smelting Works states that he has made several experiments on the sulphide ore at the Renison Bell, and is satisfied with the result.

Mr. Donald Clark, in his "Australian Mining and Metallurgy" (p. 224), seems to think that the ore at the Cornwall Mine, which is mainly pyrrhotite with a little pyrite and arsenopyrite, could be roasted and concentrated for 15s. per ton. Mining costs would probably be between 8s. and 10s. per ton: development 4s. to 5s. Altogether, with tin at its present price, sulphidic ore of 1 per cent. quality might be expected to pay working expenses. If these properties are ever to be exploited seriously, it is manifest that the present is a highly favourable time.

I paid a visit to the Commonwealth section, now E. Flight, 271-M, 77 acres, where the tunnel has been driven into the Cornwall (New Dalcouth) property to the south. The tin-bearing pyrites in this tunnel appears to have a

trend east of north, while the axinite vein bears west of north.

The tin ore is scattered visibly in places through the pyrites. Outside the tunnel entrance (on the Commonwealth ground) is a rich face of lode-matter composed of oxidised iron, quartz, tourmaline, arsenical pyrites, pyrite with visible crystalline tin ore. Lower down an open drive was begun by optionees, apparently with a view of opening up the lode at a lower level; but work here was abandoned by them for some reason or other.

I visited the exposure of the large lode on the creek on the Commonwealth, consisting of pyrrhotite, arsenopyrite, pyrite, with some copper pyrites. Mr. Montgomery's samples from this outcrop assayed 2·1 per cent. of tin and 3 dwts. 6 grs. gold per ton. The ore is evidently mixed with arsenopyrite in considerable quantity. Very careful selection is necessary here to determine any payable zones of metal. On this section (Flight's) an alluvial or surface formation is being sluiced very successfully in the central and north-western part of the property.

On the same line further north-west is a section, 1215-M, 36 acres, in the name of C. Brumby (formerly North Renison Bell), near the southern boundary of which Evenden's tribute party is sluicing a rich tin-bearing formation, apparently consisting of disintegrated quartz and sandstone. The limits of this have not yet been exposed, and it is consequently too early to say what the deposit really is. Since my visit I have heard that a still richer discovery has been made.

Renison Bell Tin Mine.

The Renison Bell Tin Mine is the chief mine at the northern end of the belt, and is at present being worked by optionees, who are producing ore by sluicing operations, and are driving underground to intersect the large pyrrhotite lode a hundred feet below its exposure in the railway cutting. For this work they have made use of the adit which was driven from the Argent River, 200 feet along what is known as the No. 1 lode. This lode is cut through by the Argent River, which exposed on its south bank a face of gossanous and soft pyritic lode-matter, from which bulk samples were taken from time to time, returning from 7½ to 10 per cent. tin. Since my visit in 1900 this face, which was then about 20 feet wide, has been cut down and the material removed, reducing the width of lode to 6 or 8 feet, and showing that the outcrop at this point pro-

bably partook of the nature of a bonanza. The bearing of the lode is S. 60° E., and its dip at a high angle to the north-east. A drive has been put in in footwall country south-east for 200 feet, and crosscuts driven through the lode at 100 and 200 feet. The first crosscut intersected the lode about 9 feet wide of siliceous and pyritic nature, but poor for tin. The second crosscut at 60 feet in cut a pyritic band, succeeded by about 30 feet of carbonate of iron and dolomite, and finally passed through another band of pyrites 9 feet wide at the end of the crosscut. The level has been resumed on the east side of the lode for 120 feet, short crosscuts west being extended into the lode at 60 and 120 feet. The first crosscut or cuddy passes through the pyritic band into flat layers of dolomite. The tin contents of the lode here are stated to be 1·01 per cent. In the next crosscut about 8 feet of pyrites are exposed. A crosscut is now being driven north-easterly to intersect the parallel pyritic (pyrrhotite) lode shown in the railway cutting. This crosscut is now 100 feet vertically below that lode, but will have to be extended to cut it on its underlay.

The No. 1 lode is shown at surface at the west end of the railway cutting, with a width of 10 feet about 150 feet further west than its occurrence underground. This would indicate that its mean underlay above the level of the drive is about 35°. In the drive, however, it is much steeper. Taking into consideration the low grade of this lode, where it has been tested underground and at surface, combined with its good return at the Argent River face, it seems likely that its richest horizon is below the river level. It will have to be proved in depth by means of a shaft sunk on the hillside above the river.

The lode, however, which invites the first attention is the Big Blow Lode, which is probably the same as the pyritic (pyrrhotite) lode shown in the Emu Bay railway cutting. This identification is not absolutely certain, as from the distance between the two outcrops (1000 feet) some doubt may very well exist. As the Big Blow outcrop is fully 250 feet above the pyritic lode exposure, its underlay would seem to carry it at railway level to the east of the railway cutting altogether. But the Blow outcrop is so huge and irregular that it is uncertain what is the true lode strike, and this uncertainty will not be removed until more work is done.

The outcrop is a quartzo-ferro-manganese mass projecting 28 to 30 feet vertical from the hill-slope, and bearing

at its northern end nearly due north, but bending round south-westerly at its southern end. The slates forming the footwall of the gossan dip to the east. The outcrop forms a mass of oxidised lodestuff which extends along the hillside, not without some interruption, for upwards of 5 chains. At the southern end it forms a continuous wall for 167 feet in length, from 21 to 30 feet in width at the top, and decreasing to from 6 to 9 feet in width at tunnel level, and this is the block of ore-bearing material which the company relies upon as an available asset.

A tunnel has been driven below the outcrop at the south end for about 200 feet into the hill, showing the underlay of the ore-body to be flat, and indicating a change of the gossan to pyrite and pyrrhotite. I have no doubt that the oxidised matter will be replaced by these sulphides in depth. The crosscuts and rises from this tunnel have fairly well established that the ore-body descends to this level, and facilitate the formation of an idea as to what approximately may be expected to be won from this large block of material. I measured the Big Blow outcrop, and confirmed in a general way the measurements upon which the company's published estimates are based. The published samplings of this block show an average content of a little over 4 per cent. metallic tin, but this is a subject which is outside the province of my report. I was shown the bore-holes in the lode from which the various samplings had been taken, and I formed the opinion that the sampling had been carried out in a systematic and efficient manner. The crosscut from the main drive where a connection has been made with surface at the southern end of the outcrop in question (viz., at 150 feet in), shows pyritic lodestuff descending in unimpaired strength, and the assay value of the lode at this depth is stated as 2·75 per cent.

The flat layers of lode-matter connected with the Blow cause some doubt as to whether the main deposit may not prove to be in the shape of a floor following the stratification of the country. The horizontal banding of the lode material might be taken to imply this, and if this theory were correct the working of the deposit might prove awkward. It would mean that the extensions and undulations of the bedding planes would have to be followed indefinitely. I am rather disposed to look upon the horizontal layers as lines of bedding which are made visible by a replacement process taking place within a more steeply inclined channel of ore deposition afforded by the planes of cleavage. On this theory future work under-

ground would consist in following the ore channel down to any depth to which it might lead.

A short tunnel a few yards to the east of the main tunnel shows disturbed country and pyritic lodestuff (a good deal of pyrrhotite). The position of this is not easy to connect directly with the Blow, and the lode being unoxidised it has been thought to be an independent occurrence. This, however, is not likely. The difference in character is probably due to the predominance of pyrrhotite, which oxidises very slowly.

As a general rule in this district, it is probable that where the lodes consist mainly of pyrrhotite the outcrop will be sulphidic, while the large outcrops of ferro-manganese indicate that the preponderating pyrites in the vein below is the bi-sulphide.

The distribution of the tin, both in the gossan and sulphide, appears to be sporadic, and variable within short distances. No general law of distribution has been discovered so far, consequently any forecast of the behaviour of the lode in depth would be founded on precarious data. Tin, however, being a metal of deep-seated origin, will certainly be found in the lode channel in sinking to a considerable depth from the present surface, which has a purely fortuitous connection with the tin ore in the upper part of the lode. There is therefore every inducement after turning the metal of the large outcrop into cash to prove the lode in depth.

The hill spur descends from the Big Blow to the railway cutting, and the form and direction of this spur lend great probability to the view that the same lode is exposed in the cutting as the pyritic lode. This is there cut through obliquely for 46 feet, which would be equivalent to a true width of about 40 feet.

The ore channel is steep and well defined, evidently parallel with the planes of cleavage and at nearly right angles with the flat bedding planes.

About 6½ chains south-east of the lode in the railway cutting is No. 6 lode, which has been trenched across its outcrop for about 1½ chain, and driven across underground for an oblique width of 26 feet. Its true width seems to be about 14 feet, and bearing, as far as can be judged, S. 70° W. It cannot be very far east of the Big Blow lode, and on my former visit I surmised that it might be identical with it; but I am now inclined to think that the two are distinct, and that this crosses the line of railway below the embankment. A useful piece of work would be

to put in a deep exploratory crosscut into the spur from this side, which would intersect all lodes coursing down the hill. It is a rather solid pyritic lode, with a considerable admixture of quartz, but not rich in tin at this level. Its dip is south-easterly, and it is conformable with the foliation planes of the country. It forms the slope as it were of the camp gully, and hence is easy of attack. Near the end of the drive some further pyritic veins have been passed through, and in the face flat replacement veins of pyrites occur which evidently mark bedding planes.

What is called the "White Lode," or a zone of white sandstone and conglomerate, has been intersected by the railway cutting for a width of some 48 feet. The same zone is prolonged 6 chains further south, where an underlay shaft and some trenches have been excavated in it. In sinking the shaft 25 feet, quartzite was followed by white conglomerate, and the latter by pug. Mr. Briggs informed me that he obtained prospects as much as 2 lbs. to the dish. A couple of chains from this a hole was put down from a trench passing through 15 feet of grit and quartzite, 3 feet of loose rubbly quartzite into soft yellow clay in which a 6-inch vein gave a rich assay. In the railway cutting the lode called the "Cross Lode" is believed to have junctioned with this one. This is a little problematical, but at any rate there is a wide belt of fissured country there which has been a channel for the ascent of stanniferous vapours or solutions, and which has contributed a good deal to the detrital formations which are being sluiced below the line.

The mineral solutions in this zone have doubtless ascended vertically, but the horizontal bedding planes give the replacement deposits their structural features. On the whole, this "White Lode" deposit is low grade, but it should be explored for locally enriched portions.

Western Lode.

A large ferro-manganese gossan outcrop crosses the boundary line between Sections 2606 and 166 in a north-westerly direction on the fall to Porphyry Creek. Its observed length is between 500 and 600 feet, and its surface width from 20 to 30 feet. On Section 2606 a short drive has been put into it for 25 feet, and 20 feet below the hard craggy outcrop. As is often the case below these outcrops, the ferruginous matter is much softer underground. Quartz veins or patches occur in it. The

enclosing strata, clay slate, lie rather flat. To test the lode at some distance down, a winze might be sunk following one wall, and adit crosscuts may be driven from the east fall of the hill to a considerable depth. There is nothing in this occurrence inviting urgent attention, but the probability is that the iron gossan outcrops so common in this district cover pyritic lodes, and the sulphides, as we know in numerous cases, are often accompanied by tin ore.

In the southern part of Section 2534 above the Big Blow trenching has disclosed several iron gossan formations, about which little or nothing is known, but any one of which may cap payable lodes.

These numerous formations on the Bell property give large scope for prospecting work.

The alluvial or detritus deposit now being worked with profitable results forms a belt of detrital tin-bearing material covering the hill-slope for a width of about 200 feet, and extending down the hill to the Argent River on the one hand, and up the hill for about 400 feet from the railway cutting on the other. The deposit seems to be about 3 feet deep. I am informed that the average depth of the test bore-holes was 39 inches, and that the assay yield was equivalent to 13 lbs. per cubic yard. I was shown the test-holes which had been put down, and noted that they corresponded with those shown upon the mine plan. The productive work in progress is, I am given to understand, generally confirming the published estimates. The deposit in question is not a bed of waterworn stones, but consists almost entirely of angular detritus, and in a large measure seems to be the waste of lodes disintegrated *in situ*, the soft country rock being amenable to the pick. The process of deposit is simply the wasting away of the lode formations, and consequent liberation of the ore which remains *in situ* for sluicing.

Taking the alluvial and the Blow outcrop into consideration, it is obvious that the owners of this property have a quantity of ore in sight, or easily accessible, waiting to be handled. Any quantity beyond this can only be disclosed by developing the lodes. The outcrop and the work on the Big Lode at tunnel level lead one to expect that the ore body will continue remunerative to a greater depth, and certainly warrant expenditure in opening up and exploring the lode. At present nothing is known throughout the entire Dundas district as to how these lodes, which within that area have a pronounced family likeness

in common, will behave in depth, and the pioneer work of testing the question seems likely to devolve on the Renison Bell owners, who may be considered as possessing a valuable property, and of considerable potentialities in its undeveloped lodes.

Lewers' Section.

The North-East Dundas tin-bearing belt continues north-westerly from the Renison Bell into the adjoining section, R. D. Lewers, 37 acres, 4550-93M. The lodes continue as three large ferro-manganese outcrops within a few chains of each other, traversing the entire section and emerging from it at its northern boundary.

On the northern fall of the hill a wide outcrop of one of these lodes has recently been discovered by Mr. Gilham. It has a favourable appearance, as these outcrops go, consisting of the usual iron gossan with a little pyrites and a considerable quantity of quartz, some of it chalcedonic. I believe it is not tin-bearing so far, but a little tin has been found by assay in other outcrops of these lodes, and possibly tin in payable quantity will be eventually found somewhere on this property. The easiest way of testing some of these lodes would be by the diamond-drill, but unless the bores were very close together the results would be inconclusive, for we may anticipate that the ore concentrations will prove extremely irregular. As said above, there is reason to suppose that the gossan will be replaced by pyritic veins in depth, and having regard to the nature of this metalliferous belt I see no reason for doubting that some of them will be tin-bearing.

In concluding this report of my brief visit to the northern end of the Dundas tin district, signs and evidence support the view that the whole district is one of undeveloped wealth. The quantity of alluvial and detrital tin which has been produced, and which is increasing every week, shows that the tin-bearing formations are more numerous and better than hitherto supposed. The present price of the metal is acting as a stimulus to the efforts of working parties to sluice wherever possible. This must inevitably lead to attention being paid to the lodes. It is true that the lode cappings are in many cases, but not always, poor or barren, but it is not likely that that will be the last word on the subject. The scratchings and chippings upon which discouraging estimates have been based will have to be followed by more venturesome work in the shape of testing the lodes at a reasonable depth on

the quite reasonable ground that tin is an ascending metal. The pyritic lode-stuff will, of course, necessitate treatment to which our tin-mine owners have been unaccustomed, and in some cases the accessory minerals (arsenides, &c.) may prevent the ore from being easily amenable to profitable metallurgical treatment; but these instances are exceptional, and do not affect the prospects of the field as a whole. A very promising feature in much of the so-called alluvial of the district is that it is really the waste of lode capping *in sitû*, and consequently that the fresh discoveries of alluvial which are now being made every month mean so many additional lode formations brought to light. With the present favourable market conditions, it would be a pity to let the time go by without making a serious attempt to test some of the lodes at deep levels.

I have the honour to be,
Sir,
Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

W. H. WALLACE, Esq.,
Secretary for Mines, Hobart.

JOHN VAIL,
GOVERNMENT PRINTER, TASMANIA

TASMANIA

REPORT

OF THE

SECRETARY FOR MINES

FOR

YEAR ENDING DECEMBER 31

1907

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REPORT OF THE SECRETARY FOR MINES.

Mines Department,
Hobart, 18th May, 1908.

SIR,

I HAVE the honour to submit my Report upon the Mines Department and the Mining Industry for the year ending 31st December, 1907.

GENERAL REMARKS.

The aggregate value of the minerals and metals raised during the year was £2,777,150, the highest yet attained; being an increase of £20,012 on the value of the output for the preceding year. During the first half of the year the market prices for tin, silver, and copper were fairly high. At the beginning of the year tin was quoted at £192 10s. per ton; it reached £200 on the 3rd July, and receded to £125 10s. at the end of the year. The average price (taken from the Mt. Bischoff Company's weekly London advices) was £175 8s.

Silver started at 2s. $7\frac{7}{9}$d. per oz., and with small variations retained its value until October, when it averaged 2s. $4\frac{7}{72}$d. for that month, falling back to 2s. $1\frac{41}{144}$d.; giving an average for the year of 2s. $6\frac{183}{1000}$d.

For the month of January, copper averaged £106 17s. 1d. per ton, falling back to £98 13s. 6d. for April, and continuing gradually to fall in price until averaging only £60 0s. 1d. for December; the average for the year being £87 1s. $5\frac{3}{4}$d.

The number of leases issued during the year was 892, embracing an area of 31,255 acres; as against 730 leases, of 19,912 acres, during the previous year. The total area held under lease on the 31st December was 77,610 acres.

In my last Report I drew attention to the desirableness of increasing the vote for tracks to mining fields, and I was very pleased to notice that the amount on the Public Works Schedule for 1907-8 had been considerably increased; the amounts being—Roads, £6850; Tracks, £3100; and Bridges, £170; a total of £10,120.

Many of the existing tracks require cleaning out again, especially the Harris Reward, Jukes Proprietary, Linda Valley to King William Range, and the track between Queenstown and Mt. Read. The intervening country between Queenstown and Zeehan is worthy of some attention being paid to it, in the way of tracks for facilitating prospecting.

The industry is a most important one, and should be fostered and encouraged in every possible legitimate manner. The opening-up of tracks is of little value to prospectors if they are not kept clear and open.

It has been pointed out that in the wilder parts of the West Coast it would pay the Government to establish nuclei. If a prospector takes a horse out with him he has to carry horse feed as well as provisions, and consequently can only carry sufficient supplies for a few days, and when they are running out he has to return again to replenish them. A great deal of valuable time is thus spent in travelling, and men become disheartened and give up in despair. If small areas were burnt out during the summer and laid down in grass seeds they would be of immense assistance to the prospector, who would then be certain of obtaining horse feed, and could use the horse for packing out his kit and provisions.

A number of suspension bridges and cages have been erected over some of the deep gorges and rivers on the West Coast by the Public Works Department, under the

supervision of Mr. James Harrison, Inspector of Mines, and these have proved of great benefit to prospectors.

Applications for reward claims, for an aggregate area of 400 acres of land, have been lodged for the discovery of manganese, zinc-lead, nickel, copper, and scheelite, in new localities. The lastnamed mineral has been discovered on the south coast of King Island. The lode is stated to be from 12 to 20 feet wide, the walls well defined, and there are 200 feet of backs. There is a plentiful supply of water and wood, and a good shipping port within half a mile.

The lode is said to carry, in addition to scheelite, considerable quantities of molybdenite, bismuth, and tantalite. A bulk assay of the ore, made at the British Flag Company's plant, on the Fraser River, has proved that 80 per cent. of the ore contents can be saved in treatment. The Government Geologist will probably visit the island in September, when an extensive examination of this, and other deposits, will be made and reported upon.

The demand for the Geologist's services has been found to increase to an extent that renders it impossible to meet the requirements of applicants, who are legitimately entitled to satisfaction. Outside his geological work, he, as Chief Inspector of Mines, together with the inspectors, has official care of the mines of the State, and his duties in this connection necessarily make inroads on his time. Consequent on the recent remarkable expansion of mining, a state of things has arisen under which geological examinations in various parts of the island have left no time for inspections in the more important districts of the Western Mineral Division. The Department found itself obliged to take into consideration the matter of reviving the appointment of an assistant, a post which has been vacant since the retirement of its last occupant, in 1904. A direct request to the same effect was also received from the West Coast, and it was recognised that the time had arrived for terminating a state of things which was unjust to the

growing industry. Accordingly, the appointment of an Assistant Government Geologist has been made, and it is believed that in Mr. Leonard Keith Ward, B.A., B.E., a brilliant graduate of the Sydney University, a choice has been made which will redound to the credit of the State.

It is desired to mark the importance of this new departure, and to impress it with the stamp of permanency by giving to the geological branch the title of Geological Survey. The intention is to commence making systematic geological surveys of the mining fields, one by one, and issuing maps of same and reports thereon, as the work progresses. An effort is being made to issue the geological publications in an improved style, and in a form which will correspond with the increased requirements of the important industry to which they relate.

Since his appointment, Mr. Ward has furnished geological reports on the Mt. Farrell field, and the western portion of the country traversed by the Great Western Railway survey route from Linda Valley to Mt. King William.

Mr. Ward will proceed to the West Coast about the end of June, and will be engaged for some months making a geological examination of the country and mines in the North-East Dundas district, in continuation of the work the late Assistant Geologist (Mr. G. A. Waller) was engaged in about four years ago.

Upon a recent visit to Zeehan my attention was directed to the desirability of more frequent visits to the West Coast being made by the Government Geologist, and to the advisability of stationing the Assistant Government Geologist permanently at Zeehan.

Since Mr. Waller retired from the service there have been so many demands upon the time of the Government Geologist that it has not been possible for him to give any attention to the West Coast, but now that he has an assistant, he will probably be able to make periodical visits to the more important centres.

Mr. Ward is already devoting all his time to West Coast work. The mere fact of his taking the train from Launceston, instead of Zeehan, does not affect his work in the least. There are many good reasons why he should return to headquarters to write his reports and prepare his geological plans, assays, analyses, &c., all of which were discussed and fully considered before Mr. Ward was appointed.

Appendices.

Appended will be found the following Reports:—

- Annual Report of the Mount Cameron Water-race Board.
- Report of the Government Geologist.
- Report of the Assistant Government Geologist.
- Report of the Chief Inspector of Mines.
- Reports of the Inspectors of Mines.
- The Government Geologist's Reports on:—
  - Mathinna. (Part III.)
  - Mangana.
  - Port Cygnet.
  - Bell Mount.
- A Paper by W. H. Twelvetrees, on the Geology of Tasmania.
- A Paper by A. Osann, on an Enstatite Augite-bearing diabase from Tasmania.

Gold-mining.

The total quantity of gold won during the year was 65,354·252 fine ounces, valued at £277,607, being an increase of 5330·855 ounces, and £22,644, on the previous year.

A quantity of gold has been obtained in the tin drifts on the North-East Coast, particulars of which will be found in another part of this Report, under the heading of "Bucket Dredging."

Beaconsfield.—The yield from this district was 35,820½ fine ounces gold.

The Tasmania Gold Mine has been the principal producer, with 32,401 ounces of gold. The total quantity of gold won from the mine is 670,893 ounces. Owing to the mine being flooded last year it became necessary to construct very extensive protection works at Blythe Creek, and 3500 feet of fluming, 28 feet high, were erected, giving a further waterway above the level of the fluming 40 feet wide. The sinking of Grubb's shaft was continued to a depth of 1311½ feet.

During the last quarter of the year the company purchased the North Tasmania Mine; the ventilation was improved, and prospecting operations at the 400-feet level were started.

The East Tasmania Company has been, by means of the diamond drill, trying to locate on its property the continuation of the Tasmania Company's reef.

Lefroy.—The New Pinafore Gold Mining Company is now turning its attention to prospecting the deep lead, with a view to working the alluvial. Two thousand pounds has been provided by Parliament for the purpose of assisting the company, on the pound for pound principle—(*a*) in sinking the existing main shaft on Section 380-87G below its present depth of 1200 feet vertically from the natural surface of its mine; or (*b*) for opening up or exploring the lodes below the said depth of 1200 feet, and in otherwise prospecting and developing the mine below that depth; or (*c*) exploiting or developing the deep lead at Lefroy by driving either from the shaft known as the East Pinafore shaft, on Section 155-G, or other convenient shaft, at a depth of 340 feet or more; and at such depth in proving such lead by rising, boring, cuddying, cross-cutting, driving, or sinking, or other mining operations.

The quantity of gold won from this field was 818¾ ounces.

A little alluvial prospecting is being carried on by small parties. Operations have been principally confined to shallow workings and cyaniding the old tailings from the New Pinafore Mine.

The Government Geologist furnishes the following Report on the country between Lefroy and Back Creek:—

There is a stretch of country forming the divide between the Lefroy basin and Back Creek which has been hardly prospected at all, though it is intersected by numerous quartz reefs and ironstone formations. It is in the southern part of the broken hill range, which abuts on the sea-coast at Black Rock and 14-mile Bluff, and is, in a direct line, 7 miles from the shore-line.

It is not more than 3 miles north-east of Lefroy, and extends really to Back Creek, which makes it unaccountable why the stream of prospectors flowing to and from those centres has never been arrested midway by this rather inviting area. Its geology is comparatively simple, as the country consists of slate, sandstone, and quartzite, referred in Tasmania to the Ordovician system. The strike of the strata is about N. 30° W., with a general dip to the S.W. In the Back Creek basin these are overlaid by Tertiary basalt and infra-basaltic auriferous drifts of middle Tertiary age. No intrusive igneous rock appears in the district. The nearest signs of granite are boulders and stones of this rock, which may be seen in alluvial ground on the east side of Slaty Creek, above the bridge on the George Town-road, and a little further along the road towards George Town, where a little prospecting was done a few years ago, under the impression that the occurrence was a granite outcrop. Similar stones are seen near the Volunteer, south of Lefroy, and Mr. Richards, of George Town, informed me that he has recently discovered some solid granite, a few miles N.E. of George Town, on the iron ore reward claim. It is probable that these boulders mark the line of underlying granite, though the

fact that the stones which are found are of different varieties of granite makes one hesitate.

The reefs throughout the area under review observe, for the most part, a strike corresponding with that of the Lefroy lodes, namely, approximately, east and west, or a little north of east and south of west; only when they follow the planes of the country do they assume directions nearer to north. The reefs, therefore, form a series north of and parallel with the Lefroy reefs. There is another set of reefs in the district which conform in direction with the north-westerly strike of the strata. Many of these reefs are formations of clayey iron oxide or slaty gossan, sometimes carrying inter-laminated quartz. They apparently occupy the place once occupied by the country rock, afterwards penetrated and replaced by pyrites, bearing silica, and finally becoming what they now are by oxidation of the pyrites. Such formations frequently carry free gold, which has been probably released from the pyrites. They have not been followed down by mining works sufficiently deep to trace their change into normal quartz reefs in depth, but there is no reason to doubt that this change takes place. What is their exact connection with the ordinary quartz reefs of the district is difficult to say until more is learned of their occurrence and behaviour. Mr. Alex. Montgomery, a former Government Geologist, considered that they had no connection with the auriferous series of lodes. Since, then, however, gold has been found in them. From an occurrence at W. G. Barker's show, where a normal quartz reef impinges on one of these ironstone lodes, I am inclined to think that the latter type is of slightly earlier date than the ordinary quartz series.

In this district, and apart from the Back Creek field, where three or four parties are working, three parties are carrying on work at present, which may be described as of a prospecting nature.

Messrs. Hart, Gaunt, and Barker, are sinking to prove an ironstone reef on one of their three 20-acre prospecting

claims. Mr. Ignatius O'Keeffe is prospecting quartz reefs south of Mr. W. Barrow's farm, and Mr. Barrow is proving a quartz reef south of the track to Back Creek. This is all the work going on over an area of several miles of country.

Hart, Gaunt, and Barker's Sections (H. No. 1 Mine).—In about the middle of the central section, in February last, Mr. W. G. Barker made a gold discovery at the contact of a quartz reef, striking N. 75° E., and dipping N. W., with an ironstone or gossan formation striking N. 30° W., and dipping S.W. The quartz reef has been cut across at surface by 13 trenches and excavations in a distance of 340 feet. Its width varies from a track to a couple of feet. No gold has been found in this reef apart from the contact occurrence. At the north-east end of the line of trenches the sinuous strike of the country slate and of the gossan formation mentioned above brings the latter again into contact with the line of the quartz reef. An assay of the gossan has given 2 dwts. per ton.

A small shaft, 14 feet deep, was sunk at the other end of this line where the gold was first found, as much as 3 ozs. per ton, and the reef was driven on both ways for 28 feet without finding gold. Its width was 1 foot. Twenty feet west another shaft was sunk (the 36-feet shaft), and openings were made at 10 feet, 19 feet, and 36 feet. At 10 feet a connection was made with drive from the 14-feet shaft. In the roof of the level the footwall of the quartz reef, dipping W., is shown, abutting on the footwall of the gossan formation dipping S. Specimens of gold were obtained from this drive close to the contact of the iron and quartz. Small leaders of quartz penetrate the gossan, and the latter then yields good prospects of gold. The quartz reef is not seen for 12 or 14 feet in this drive, which has been extended west from the shaft for 26 feet. At the 19-feet a crosscut has been opened for 24 feet, cutting through the gossan, which widens from a few

inches to a foot. The country is softer for a foot above and below the flat gossan, consisting of reddish, streaky slate. The gossan dips at a low angle, 30°. An assay has returned 2 dwts. 16 grs. per ton. At the 36-feet a level has been driven east and west (253°) 17 feet E. and 49 feet W. along the course of the quartz reef. The east drive shows the reef in end 1 foot wide, but barren. The slate country in the drive strikes N. 30° W. The reef in the west drive is followed on the south side, but towards the end appears to have broken, and to have been recovered only in the north arm of a "T" crosscut at the end of the level. No gold having been met with in this level there does not seem to be much encouragement for continuing work on the quartz reef.

A couple of chains to the south-east of this shaft is an excavation called the central shaft, which has been sunk partly on the underlay of the gossan lode for 11 feet, and a drive then opened out for 17 feet under the flat gossan. The gossan here is barren, or yielding only a trace of gold. A main shaft is now being sunk 36 feet to the south of the 36-feet shaft, and has now reached a depth of 80 feet. It has passed through the gossan reef, and is being continued to below ground water-level, when a crosscut will be opened out and the reef proved. Where passed through in the shaft at 35 feet down the gossan shows only traces of gold by assay, but in depth it is hoped that the iron oxide will have been replaced by gold-bearing quartz. At any rate, this is the best way of ascertaining what these ferruginous formations really are below the superficial zone of alteration. The ironstone channel is underlaying away from the quartz reef as it descends, and there can be no further junctions of the two. The latter will probably continue on its course for an indefinite distance; but the former is the reef which has to be proved at this mine, and only continued work can show at what depth an alteration in the filling will take place.

C. Barrow's Shaft.—This is on a reef about ¼-mile north-east of the farm about 2 feet wide and striking N. 80° E., with a southerly dip. It has been trenched upon in four places east of the shaft, but some of the trenches have not been deep enough. The shaft is sunk on the reef to a depth of 20 feet. The stone is white quartz, with some impregnations of finely-divided galena. This is one of the few reefs in the district which are mineralised, but the location in it of any gold shoot would be purely speculative work, though the presence of galena is an indication that it is auriferous at some point in its course.

O'Keeffe's Section.—Mr. Ignatius O'Keeffe has uncovered an ironstone reef south of Barrow's farm, striking 303°, and has prospected about on surrounding formations, of which there are several.

Back Creek.—This district is one of the alluvial leads which were at one time worked by a large number of men, and are estimated to have yielded between 9000 and 10,000 ozs. gold. Spurs running in a south-easterly direction carry down alluvial drift in lines known as Old Lead, Red Lead, White Lead, into the Back Creek basin. The two latter leads, at their eastern terminations, plunge beneath a Tertiary basaltic lava sheet. These leads, which are mostly on the hill slopes, therefore belong to a time prior to the flows of lava, when their present channels were the bottom of their respective valleys. The White Lead is the most northerly of the three, and is about ¼-mile long by a couple of chains in width. The white clay of the wash has given the lead its name. Parry and Birkett's claim comprised perhaps the richest ground. The wash consists of sandy clay, white vein quartz, and ironstone. The ground has been worked over and over again. Its depth is from 2 to 7 feet.

Gilham's shaft is at the head of the White Lead. A small shaft has been sunk here recently to a depth of

10 feet, and a short drive has been put in for 17 feet south, cutting a reef with a south-east strike and a north-east dip, but the level is too shallow and the stone too poor to claim much attention.

North of the above is Gilham's reef near the top of the spur, and 70 feet above the gully. A reef of kindly-looking quartz 2 feet wide has been cut through. It strikes N.W. and dips S.W. The stone is iron-stained, but barren. It was worked some years ago. This side of the spur has not received much attention, but it has no doubt shed some of the gold found in the lead.

The Red Lead is so called from the ferruginous nature of its wash; is three times the length of the White Lead, and is separated from it by a low spur. The drift is often a red cemented sand, 17 or 18 feet deep. A great number of diggers' holes exist everywhere, generally 12 or 13 feet deep. William Birkett has some alluvial workings in it, and is now attempting to drain the flat. Both above and below his workings is dirt valued at 1 oz. to 1½ oz., but nothing could be done here owing to the water. Further north, Easther and Gibbons are working the furthest claim on this lead, which runs up against the dividing saddle at the Franklin Mine.

On the north side of the saddle is the old Australasian slate quarry, and on this side, too, there is deep ground, 25 to 30 feet deep.

There is nothing in any of the reefs hitherto discovered at Back Creek to lead one to suppose that they were the source of all the gold obtained from the leads. The principal source has still to be discovered. There has been a good deal of prospecting from first to last, and it is surprising that some valuable reefs have not been found, especially as the angular character of much of the gold and quartz shows that the auriferous stone and gold have not travelled far. It may be that future prospecting work will be more successful. One thing is certain, viz., that

careful and intelligent prospecting cannot fail to throw light on the subject.

Mathinna.—The New Golden Gate Company has been sinking below the 1800-feet level and prospecting the reefs below that depth. The company crushed 2042 tons of quartz, from which it obtained 2392 ounces of gold, employing an average of 45 men. The total quantity of quartz obtained from the mine is 271,348 tons, which has yielded 227,417 ounces of gold. The total amount paid in dividends is £355,200, or £11 2s. per share; and the total amount paid for Dividend Tax is £16,638 10s.

The Tasmanian Consols Company has been reconstructing its concentrating works, constructing a haulage line from the shaft to the battery, and making other surface improvements.

Golden Horseshoe.—This mine is situate at about 1½ mile from Mathinna, on a hill bounded by the junction of the South Esk River and Dan's Rivulet. A temporary main shaft has been sunk 65 feet, and it is expected to pass through the lode at 100 feet. This lode is gold-bearing on the surface. A prospecting shaft has been sunk on gold-bearing stone to a depth of 80 feet, but the country passed through is very much disturbed, and the gold-bearing stone is small. The company has purchased a 10-head battery within easy access of the workings. This battery is run by a turbine capable of giving 10 to 12 horsepower, supplied by a water-race 2½ miles in length.

Lisle and Golconda.—Two hundred and nine ounces of gold have been won from these fields by alluvial mining, 17 men having been employed.

Lyndhurst.—Early last year interest was revived in this field through a number of sections having been taken up, which have since been forfeited. The Lyndhurst Company is prospecting the old Southern Cross Mine.

West Coast.—Very little gold is now obtained by alluvial miners on the West Coast. Many of the old hands have left the fields, and there appears to be little inducement for younger men to take up the work of the old pioneers.

Port Cygnet and Petchey's Bay.—Attention has been paid again to deposits of gold in this district. The alkaline porphyries have intruded into the Permo-Carboniferous strata here, and the quartz and altered rock at the junction between the two carry gold at various points. Some of this has been shed into the creeks and flats, and a good deal has been recovered at different times. As far as is known, about 3000 ozs. have been won altogether.

The Petchey's Bay Gold Mining Syndicate has lately bored the shores of the Huon River at Wheatley's and Kube's bays. Coarse gold was obtained from the former, and very heavy gold has been got from Riseley's Creek. The syndicate intends thoroughly testing these bays and the bay at Lymington before starting with a dredge. A certain quantity of gold is sure to be present, but those interested in the venture should assure themselves that there is scope enough for a dredge before making a commencement.

At Mt. Mary, near Port Cygnet, a working party has sunk a shaft 73 feet, and driven 6 feet on a siliceous formation at the bottom, not far from the porphyry junction. Samples from the face have been assayed in the Government Laboratory by the Analyst, Mr. W. F. Ward, but only a trace of gold was detected in them. On the other hand, a small piece of reddish contact rock from the trench at surface, which showed specks of gold, assayed 3 ozs. 4 dwts. gold and 2 dwts. 12 grs. silver per ton.

On Mt. Livingstone a shaft has been sunk about 60 feet on porphyry banded with quartz, carrying small quantities of galena, blende, and arsenopyrite, but samples

taken from the heap and selected from the most likely-looking stone yielded only a minute trace of gold. None of the reef matter in these occurrences round Port Cygnet has ever been found to contain gold in payable quantity. The quartz appears to be a contact development, and swells and disappears alternately. The brecciated line of country along the contact has undoubtedly shed the gold which has been won from the alluvium. The latter has been derived from the slow waste of the hills, and as it does not carry gold in large quantities, it may be assumed that the reefs or formations exposed are not rich. The occurrences of gold may be looked upon as irregular, and likely to be payable only when some unusually rich shoot is struck. The chance of finding these pay-shoots may be regarded as a matter of prospectors' luck. The most that a geological examination of the ground can do is to point out the lines along which search may be most usefully made.

Silver-lead Mining.

The quantity of silver-lead ore produced was 89,762½ tons, valued at £572,560, being an increase in quantity and value of 2644¾ tons, and £110,117, on last year.

The silver-lead mines on the West Coast are now well established, and are producing regular outputs. The principal producing mines are the Mt. Zeehan (Tas.), Zeehan-Montana, Zeehan-Western, Florence, Oonah, Silver Queen Extended, South Comstock, &c.; and at Mount Dundas, Comet, West Comet, and Hercules.

Zeehan District.—During last session of Parliament a sum of £3000 was voted for the purpose of assisting the Zeehan-Western, Limited, on the pound for pound principle, for the purpose of sinking its shaft and opening and exploring below the 800-feet level. The shaft is the deepest on the Zeehan field, and it is hoped that operations below that depth will result in proving the continuance

of the rich lodes which exist at shallower levels in the mine, and thus inspire confidence in other mines on the field by establishing the existence of lodes at a depth.

At the Florence Mine there has been very decided improvement. A new lode has been opened up, which has given good returns to the company and the tributers.

At the Colonel North Mine (Grubb's) the machinery is receiving a thorough overhaul; when this is completed the mine is to be unwatered.

At the Victoria Zeehan Mine work has been confined to sinking the main shaft, which is now down to a depth of 180 feet.

Operations at the lower levels of the Oonah Mine have been suspended pending the erection of a plant to treat large bodies of stannite ore which have been opened up.

At the Comet Bell Mine the main shaft has been put down for another level, and driving for the lode has been started. Several parties of tributers are working between No. 2 level and the surface with satisfactory results.

Sunrise Company to the south of the Comet Bell Mine, has erected a large water-wheel, and will resume mining operations when this is completed.

Dundas District.—The Comet Mine is being worked on tribute.

The West Comet is sending out large quantities of fluxing ores to the smelters at Zeehan.

The Adelaide Mine, after having been shut down for some years, has been taken up by a strong English company, and a pumping and winding plant has been erected. The main shaft is being repaired.

Mt. Read District.—The Hercules Mine is maintaining a steady output of sulphide ore, and developments of a favourable character have taken place in No. 4 workings.

Prospecting, by means of a diamond-drill, has been carried on for some time north of the Hercules Mine, but no satisfactory result has yet been attained.

Rosebery District.—The Tasmanian Copper Company has been forwarding about 1000 tons of ore per month to the Zeehan smelters.

The Colebrook Company is completing the erection of its smelting furnace for the treatment of its own ore and that of other mines in the vicinity.

Mt. Farrell District.—The North Mt. Farrell Company has completed its water-power scheme, and has started the construction of a steam tramway (in lieu of the wooden tramway) to the Emu Bay Railway-line. It is roughly estimated that the company has 60,000 tons of ore opened up and ready for stoping.

The other mines in this district, viz., the Mt. Farrell, McIntosh Tribute, and Tullah, are all working with very encouraging prospects, and there is every confidence of a bright and prosperous future for this field.

Mr. L. K. Ward has spent some considerable time in making a geological examination of this field, and his report is now in the hands of the printer, and will be published shortly.

North-Western District.—The Magnet Silver Mining Company has replaced the steam plant for driving the concentration mill by a hydraulic plant. This consists of 3 miles of races and a pipe column 1300 feet long by 20 inches diameter, the whole being capable of supplying about 300 horsepower. Besides the mill, the air-compressor plant is also driven by the use of Pelton wheels. The wheels are actuated under a total head of 410 feet, and it is intended to use the surplus power for winding and for generating electricity for lighting purposes.

The concentrating mill is under reconstruction. Its capacity will be 800 tons per week—and it is being built on the step-by-step reduction and concentration principle, with the object of dumping nothing except in the state of fine sands. The crushing appliances consist of 30" × 15" rolls and 5-feet grinding pans of the Watson-Deny type. The dressing machines are Hartz and May compound jigs, card tables, Luhrig vanners, and canvas straights. The sizing will be done by trommels, shaking screens, Callow screens, and thickening boxes.

The main tramline has been reballasted for its full distance of 10 miles. A telephone installation has also been made.

The pumping and winding are done by means of compressed air, and owing to the growth of the mine this work will shortly require enlarging.

The mine has continued to open up splendidly. The No. 8 level crosscut has just cut the lode at its deepest point. The formation is 60 feet wide, 40 feet of which is fair milling ore, and 5 feet is fit to send straight to market. Drives have been started north and south, but no stoping has been done, the whole of the ore being thus in reserve.

The No. 7 level main crosscut immediately above showed the lode to be 44 feet wide. This is now being stoped. Up to the present 400 feet has been driven on the lode with the face in the south drive carrying 5 feet of marketable ore (crudes) and 14 feet milling ore. About 28,000 tons of ore have been mined during the 12 months, and about an average of 190 men employed. It is stated that about three years' ore is in sight at the above output.

Copper-mining.

The total quantity of copper and copper ore produced was 9035¼ tons, valued at £869,666. This shows a decrease of 1889¼ tons, and £65,258, on the previous year.

The output of the Mount Lyell Mining and Railway Company, Limited, has been steadily maintained, the mine having produced 8247 tons of blister copper, containing 8144 tons of copper, valued at £745,253 8s. 9d.; 697,120 ounces of silver, valued at £87,437 13s. 7d.; 19,265 ounces of gold, valued at £81,876 5s.; a total value of £914,567 7s. 4d., being a decrease of £40,806 19s. 6d. on the previous year. The amount paid in dividends was £330,000.

The principal event has been the attaining of a vertical depth below the surface of 1000 feet, at the Mt. Lyell Company's North Lyell Mine, and locating thereat, on both sides of the main shaft, a continuation of the profitable ore-bodies that have marked the development of this mine, the stability of which may safely be reckoned as equalling that of the parent.

Workings at the latter pyritic extractions for smelting and chemical (superphosphates) purposes continue unceasingly, while at the reduction-works a series of turbo-blowers are being installed in order to assist or supplant those (Root's) now in existence.

The Consols Company is erecting a concentrating plant, and is completing the erection of a winding-plant on its main shaft.

On the northern fall of Lyell, and facing the Sedgewick Valley, the Tasman Lyell Extended and the Comstock Consolidated mines have continued prospecting; the former persistently, while the latter has had recently added to its plant a portable Pioneer diamond-drilling machine worked by a gasoline motor. That, as it becomes known, must prove a boon to prospecting isolated places, as there is no part of the machine that cannot be carried by a man. It has attained a depth of 150 feet in conglomerate, and is capable of accomplishing from 400 to 500 feet.

Work of a desultory character has been done on the copper mines of the Mt. Lyell West, Old Juke Lyell, and Great Lyell South sections.

At Darwin, the Thompson P.A. has kept a couple of men going on its property; likewise the Wood Syndicate. Both need capital.

Mr. W. H. Taylour, of Queenstown, has forwarded to the Department samples of copper ore from mining works on the Darwin Copper Syndicate's leases at east and south Mt. Darwin. During the past month encouraging results have been met with while exploring the country close to the conglomerate capping of the sub-range upon which the old Darwin Proprietary and South Lyell leases are situated. Some 500 feet above the old underground workings, where the pyritic ore occurs, and in contact with the red sandstone associated with the conglomerate capping, a belt of talc-like schist has been struck, similar in many respects to that prevailing at the North Lyell and Tharsis Mines. In several places in this schist veins of cupriferous pyrite occur. This schist has been traced by the syndicate for about 6 chains, and wherever it has been cut into, veins of rich ore have been struck. One vein is a foot wide, and the ore fairly solid, where struck in the drive. It is intended to put in an adit 200 feet below this, and the owners hope to locate an ore-body of appreciable dimensions. Some of the pyritous ore contains high gold values (0.85 oz. per ton). What looks like a fissure-lode has been discovered on the granite plateau of South Darwin, showing dense iron sulphide, stated to be associated with some copper. During the summer it is hoped to prove this lode by driving below the outcrop. This belt of country, which is the southern prolongation of the Lyell-Farrell line, deserves the attention of the geological staff.

Tin-mining.

The quantity of tin ore raised was 4343 tons, valued at £501,681, an average of £113 4s. 2·72d. per ton.

The statistics for this metal for the past year have been:—

District.	Ore won. tons	cwts.	Men employed. Europeans.	Chinese.
Northern and Southern Division	29	15	23	—
North-East Division	2770	10	872	94
Eastern Division	521	12	329	34
North-Western Division ...	136	5	62	—
Western Division	884	14	397	—
	4342	16	1683	128

Northern and Southern Division.—The only mine working in this district during the year was the Shepherd and Murphy Mine, near Middlesex.

The Cox's Bight tin field has been abandoned.

North-Eastern Division.—Briseis Tin Mines, Limited, has been the largest producer, with 1017½ tons of tin, and distributed during the year £112,500 in dividends. This company has taken over the tin mine on the other side of the Ringarooma River, recently held by the New Ringarooma Tin Mining Company, and during the year brought in a supply of water from the company's main race, for the purpose of working the property.

The New Brothers' Home Company, which adjoins the Briseis Tin Mine, is being worked by the Briseis Company; it has produced 394¼ tons of tin ore, and has distributed £16,500 in dividends.

The Arba Company has been working persistently, and has produced 97¼ tons of tin ore.

The Moorina Tin Mining Company has been systematically following the deep lead, which, on account of the great overburden, has been compelled to suspend operations pending the raising of further capital to work upon a large scale.

Pioneer Tin Mine has produced 301¾ tons of tin ore, and has paid £24,975 in dividends. On the 6th February 10 inches of rain fell in six hours, and the bywash from the lagoon would not carry this quantity of water, which broke over into the workings and filled them up. The bywash has been cut down and enlarged. A deep cutting from the river has been brought up, and the creeks confined to their original channels round the lagoon by a high earth embankment, protecting the workings from further floods. The new plant has been finished (a plant for working the bottom bench of ground), and fitted with a nozzle to utilise the drainage from the tailings paddock. Ground is being prepared for a large dam-site up the Frome River, preparatory to making a start on it. Boring operations are still in progress on the company's leases, and have proved the area of payable ore marked out for working to be very much greater than was originally supposed.

South Mt. Cameron Tin Mining Company.—The plant consists of two high-lift centrifugal pumps, capable of discharging 5000 gallons per minute against a 240-feet head of water, and five high pressure underfired boilers steaming up to 140 lbs. to the square inch; one vertical compound surface condensing engine, capable of developing 250 indicated horsepower with economy; one Allen engine of the two-crank compound double-acting self-lubricating type (imported), capable of developing 400 indicated horsepower; three boilers, feed water-pumps, and condensers; also one of Edwards' air-pumps.

Electric Light Plant.—One high-speed direct connected engine and dynamo of self-contained design, capable of running twelve large arc lamps and 50 incandescent lamps.

The mine is situate on terrace land, consequently all the water has to be pumped up from the Ringarooma River, and in some places conveyed through spiral riveted

pipes, 18 inches diameter, for a distance of 3000 or 4000 feet, and then by 12-inch pipes to the giant nozzles.

The wash in many places requires from 50 to 60 lbs. per square inch on the nozzle-bits to break up the hard cement wash small enough for the sluice-boxes. The particular advantage of the ground is that no such thing as overburden exists; the tin oxide existing in the wash and drifts occurs from surface to bottom, thus rendering everything passing down the tail-race reproductive. The two tail-race boxes extend from the working faces to the river, about ½-mile in length, consequently all the hard matter has the chance to break up and deposit the oxide in the boxes instead of the river. During the past year 41,200 cubic yards of hard bottom was removed to make room for the sluice-boxes, &c., and 134,800 cubic yards of drifts and wash were treated for 71 tons 12 cwt. of tin oxide, and 82 ozs. 15 dwts. of gold saved. The average number of men employed was 42.

Purdue Tin Mines.—This company holds about 300 acres of land. A large proportion of the ground is said to carry tin, but the exact area that may reasonably be considered payable cannot be stated until systematic boring has been carried out. The highest point of the company's ground is about 200 feet above the Ringarooma River. It is therefore necessary to lift water to that height from a race which takes its supply from the Ringarooma River. This race is 4 miles in length, and is capable of carrying 100 sluice-heads of water. The machinery consists of a Babcock and Wilcox boiler, supplying steam for an Allen's Company engine, by which a turbine pump is directly driven. The pump delivers 112 sluice-heads of water, through a 3-inch nozzle, giving a pressure-head at the face of 100 feet. Sluicing operations were commenced on the 24th August, and from that date to the 16th February, 1908, 46,000 cubic yards of material have been treated, for a return of 63 tons of tin oxide. The company has installed a complete electric light plant.

The closing down of the Scotia and the Cybele mines caused a good deal of depression in the district for a time, and threw a large number of men out of employment.

The Dorset, Ringarooma, and Gladstone companies are working by means of bucket-dredges, particulars of which will be found in another part of this report under the heading "Bucket-dredging."

Eastern Mining Division.—The alluvial mines throughout the district have maintained their usual output. Small parties of alluvial miners at Weldborough, St. Helens, and Avoca have been contributing their quota to the general output.

The Mt. Lyell Company's prospecting operations over a large area of land at Blue Tier have ceased. No very good results, therefore, appear to have been obtained. The area was thoroughly and systematically tested by means of diamond-drills, but the records of the bores have not been made public.

The Anchor Tin Mine has obtained 202 tons of tin oxide. Towards the end of the year the company started to open up new faces, by which it expects to increase its returns. Certain radical changes have been made in the battery, which will greatly reduce the quantity of water required.

Western Mining Division: Heemskirk.—Mayne's Tin Mine has changed hands, and the people who are working it are well satisfied with the results they are obtaining.

There are a few small parties working on the south-west portion of the field, on the northern side of the mount.

There are about 30 tin miners employed.

North-East Dundas.—Good returns are being obtained from the Renison Bell, Brumby's Section, Duncombe, and

Maddox, Flight's, Kemp's, Penzance, Sligo's, and numerous small parties.

Stanley River.—Very little has been done on this field during the year, the drawback being the difficulty in getting supplies over the Pieman River when it is in flood. A suitable site for a suspension bridge has been obtained, and men are employed in marking off a track to the field. When this work is completed pack-horses can go straight from Zeehan on to the tin ground. There is room for a large number of miners on this neglected field.

North-Western Mining Division.—Dividends have been declared by the Mt. Bischoff Tin Mining Company, Registered, during the year, amounting to £36,000, bringing the total up to £2,124,000.

The quantity of tin ore produced during the year was 730 tons, bringing the total quantity up to 66,563 tons. Several important developments have taken place lately, and the future prospects of the mine appear to be very encouraging.

Bischoff Extended.—During the year a deep adit has been put in to cut the lode 200 feet below No. 3 level. In driving 127 feet on the lode 340 tons of lode-matter were obtained and sent to the battery, which gave a return of 30 tons tin oxide. The company has constructed a new tramline down the face of the hill, and is busy erecting a new battery at the foot. This will cause a considerable saving in cost, as there will be only one handling of the ore.

Whyte River.—The Cleveland Company is busy constructing a tramline into the mine. When completed, the battery will be placed in position. The mine is being well opened up, and the manager is confidently looking forward to good results when crushing commences.

Coal-mining.

The total quantity of coal raised amounted to 58,891 tons, valued at £50,057, being an increase of 5996 tons on the previous year.

The raisings at the respective collieries were as follows:—

	Tons.	Average Number of Men employed.
Mt. Nicholas	23,070	70
Cornwall	25,604	61
Spreyton	1417	7
York Plains	522	2
Mt. Cygnet	1289	2
Sandfly	6789	51
Woodbridge	50	2
Illamatha	150	2
	58,891	198

The Dulverton Coal Mine has been closed down, and two new collieries, viz., the Woodbridge and the Illamatha have been added to the list.

The Catamaran Coal Mine has suspended operations pending reconstruction for the purpose of obtaining more capital.

A new discovery has been made near Strathblane, Port Esperance, from which some excellent samples have been obtained. There has been a good deal of inquiry for coal sections, consequent upon the coal strikes on the mainland, and large areas have been taken up under prospectors' licence, and are being prospected.

Iron.

The quantity of iron ore mined was 3000 tons, valued at £1150.

The Blythe River Iron Mines, Limited, in the first quarter of the year, raised 1000 tons of hematite iron ore

for export to New South Wales; and the Tasmanian Iron Company at Penguin raised 2000 tons of ore.

Wolfram.

The output of wolfram was as follows:—Middlesex Mines, 16 tons 5 cwt.; Ben Lomond Mines, 37 tons 12 cwt.

The All Nations Wolfram Mine, at Middlesex, has a lode, which has been opened upon by a deep open-cut along its course for about 12 chains. It varies from 6 inches to a foot or two, averaging, perhaps, 9 inches, and has been broken out to a depth of from 8 to 10 feet. The present owners have extracted the smalls from the loose parts of the lode, and obtained 8 tons of wolfram ore by sluicing, which has ranged from 66 per cent. to 72 per cent. tungstic acid. The idea of the owners is to get capital into the property, which comprises four mineral sections, and thoroughly prove it. The mine is about 12 miles from Wilmot township.

Antimony.

At Hall's Creek, near Lynchford, Messrs. Thomas and Berry have driven across a black decomposed pug formation, similar to that in which the nodules of loose stibnite were found near the surface, but without any results of importance. Samples of the rich ore have been received from Inspector Curtain, and an assay made of some of this by Mr. F. B. Jackson, of the Mt. Bischoff smelting works, gave the following results:—

Gold	Nil
Silver	Trace
Lead	1·05%
Copper	Nil
Arsenic	0·02%
Antimony	66·57%

Bucket-dredging.

Prior to the construction of dredges on the Ringarooma River by the Dorset Bucket-dredging Company, No Liability, and the Ringarooma Dredging Company, No Liability, mining, by means of bucket-dredges, had not proved of a successful character, probably owing, principally, to the hard and rocky nature of the river beds in which they were employed.

In June, 1901, the Queen River Dredging Company constructed a dredge for the purpose of working for gold in the bed of the Queen River, near Lynchford. The plant was constructed to treat 100 cubic yards an hour, with 22 buckets, carrying 3¼ cubic feet of stuff, at the rate of 12 per minute. The bucket-rope was supplied with three sets of grab-hooks. The ladder over which the buckets ran had a telescopic stage of 8 feet, and would work to a depth of 25 feet below water-level. The water for the screen and gold-saving tables was supplied by a 10-inch centrifugal pump. The whole plant was lighted by acetylene gas. The wash was principally composed of large pudding-stone boulders, and was not of a payable nature. Operations ceased about the end of June, 1902.

The Whyte River Dredging Company constructed a dredge for the purpose of working for gold in the beds of the Whyte and Rocky Rivers on the West Coast. The machinery was supplied by the Salisbury Foundry Company, of Launceston. The dredge was not able to work successfully owing to the hard nature of the river bed, which, being full of crevices, held the gold, the machine simply puddling up the wash and leaving the gold in the crevices in the bottom. A little gold was obtained, but not sufficient to pay working expenses, and after three or four months' work operations ceased.

The Gladstone Tin Development Company, No Liability, whose property is situate at Gladstone, North-East Tasmania, was the first company to construct a bucket-dredge

in the State, for the purpose of obtaining tin by that method of mining. It was built in the year 1905, by Mr. C. Isbister, of Victoria, who also had the contract to erect the machinery.

The pontoons, which are built of Tasmanian hardwood, are 95 feet long, 36 feet wide, and 7 feet in depth.

The machinery, which is erected on the pontoons, is driven by a 35 N. horsepower engine. A separate engine is used for driving the pump (15-inch centrifugal), which is capable of lifting a stream of 40 sluice-heads of water.

Steam is supplied to the engines by a 40-horsepower multitubular boiler. The buckets which lift the dirt travel upon a ladder, after the principle of an elevator. The ladder is strongly built of steel, is 72 feet long, and will allow dredging to be carried on at a depth of 32 feet below water-level. There are revolving tumblers at each end of the ladder. The top tumbler, which causes the buckets to revolve, is geared to the main driving gear, which is driven by the main engine, by means of a belt.

The buckets have a carrying capacity of 4½ cubic feet, travel at the rate of 12 per minute, and are capable of lifting over 14,000 cubic yards of material per week. The material the buckets carry is deposited into a perforated revolving screen, 32 feet in length, in the centre of which is a stationary perforated pipe, which discharges the water lifted by the pump. The force of water through the pipe washes the dirt, the fine material and metal going through the perforations in the screen into boxes 62 feet in length and 5 feet in width, two of which are placed on each side of the screen. The coarse material is deposited at the stern of the dredge by means of a chute, which is placed at the end of the screen. The mode of working is as follows:—The dredge, being built in a dam, the bottom is reached by degrees, by lowering the ladder as the buckets elevate the dirt. On reaching the bottom, the dredge is pulled gradually across the face or dam, and then pulled ahead sufficiently to insure that the bottom will be

thoroughly cleaned up on the return journey. The navigation is done by steel wire ropes, attached to a winch, which is driven by a 20 horse-power engine. The dredge is lighted throughout by an electric plant.

The Dorset Bucket-dredging Company, No Liability.—The company was formed for the purpose of working the tin drifts on its sections near South Mt. Cameron. The pontoon was built of Tasmanian hardwood, by the company, on day labour, under the supervision of its manager.

The dredge was designed by Mr. F. W. Payne, of Dunedin, New Zealand. The hull is 125 feet long, by 48 feet wide, by 10 feet deep. The machinery was made by the Austral Otis Engineering Company, of Melbourne; and the engine, by Marshall, England. The hull was built, and the machinery was erected, by the company's manager, Mr. John Gordon.

The pontoon was floated on the 31st January, 1907, after which the machinery had to be erected, and the dredge started work in August, 1907; and up to the 31st December worked 234,000 cubic yards of dirt, for 42 tons of tin oxide and 48 ounces of gold.

The Ringarooma Bucket-dredging Company, No Liability, during the year erected a dredge for the purpose of working the tin drifts near South Mt. Cameron.

The size of the pontoon is 92 feet by 36 feet by 8 feet deep. The buckets are 4½ feet, and the dredge has worked 5084 hours, or, approximately, 212 days; and treated 242,800 cubic yards of material. The tin won amounted to 29 tons.

The capacity of the plant is estimated to be 7000 cubic yards per week.

The three lastmentioned dredges are working in close proximity to each other, and are the only dredges of their type now in operation in the State.

The following return shows the quantity and value of mineral products for the State of Tasmania during the year ending 31st December, 1907:—

Mineral.	Quantity.	Value.
		£
Gold *	65,354·252 ozs.	277,607
Silver-lead	89,762½ tons	572,560
Blister Copper †	8247 „	832,691
Copper and Copper Ore	788¼ „	36,975
Tin Ore	4342¾ „	501,681
Iron Ore	3000 „	1150
Coal	58,891 „	50,057
Wolfram	40¾ „	4411
Bismuth	3½ cwts.	27
Total	...	£2,277,159

* Fine gold, including gold contained in blister copper and silver-lead bullion.

† Value of gold deducted.

The amount paid in dividends was £616,089.

Geological and Mineralogical.

From time to time samples of Tasmanian minerals and rocks have been sent by the Department to Prof. H. Rosenbusch, Heidelberg. In the recently-published second volume of his great work on the "Microscopical Physiography of Minerals and Rocks," are numerous references to the abovementioned specimens from Tasmania. Among others, mention is made of the dyke rock at the Magnet Mine, in which the silver-lead lode now being worked occurs. The Professor says:—"Mention may be made of the fact that the peridotites and pyroxenites can also be developed in dyke form. There is lying before me a specimen from the Magnet Mine in Tasmania, which certainly is completely altered, but which, in a fresh state, would be called Websterite-porphyry. Porphyritic crystals of thoroughly chloritised pyroxene (the outlines of which point partly to monoclinic, partly to rhombic systems) lie in a groundmass of angular chlorite fragments. The

chlorite belongs to the pennine variety. Irregu
evidently secondary quartz grains are not rare
groundmass. There is singular absence of iron

Zeehan Stannite.—The stannite lodes of the
Mine have always been of interest, apart from t
nomic value, owing to the light which they thr
the genesis of the silver-lead lodes of the Zeeh
generally. Not only stannite, but also wolfram
muthinite, occur in them, an association whic
unmistakably to derivation from underlying grani
high percentage of silver, 50 to 100 ozs. per ton
ore is remarkable. Otherwise the composition agr
the typical stannite (or "bell metal ore") of Cor
far as the main constituents are concerned. The
tin content is 9 or 10 per cent. The highest pe
of this metal, obtained in Messrs. Conder and
laboratory in Launceston, has been 17 per ce
J. H. Levings, of Zeehan, has recently made a
analysis of a piece of apparently pure and hor
stannite from the Oonah Mine, and he has kind
permission to use his figures in this connection.
as follows:—

Silver	0·298	= 97·3 ozs. pe
Tin	23·27	as sulphide
,, ...	0·64	as oxide
Copper.....	26·77	
Iron	12·11	
Bismuth	2·27	
Antimony	0·505	
Arsenic.....	Trace	
Zinc	0·475	
Sulphur	32·10	
Silica	1·40	
Oxygen	0 14	
	100·278	

Mr. Levings states: "All Zeehan stannites co
as oxide; sometimes reaching 15 per cent. of t
Antimony is not an essential of Zeehan stannite

it is absent. From bulk samples I have got a trace of it, and 0·5 per cent. arsenic, the latter, perhaps, from arsenical pyrites."

Tasmanian Diabase Rock.- This rock, which in the form of trapp, sill, or laccolite, is so general as an intrusive in the Permo-Carboniferous and Mesozoic strata of the island, is readily recognizable by the eye alone. It varies in texture however, and sometimes is more siliceous in aspect than usual. An analysis of the siliceous variety from North-West Bay, near Hobart, has recently been made by Dr. Pohl, in Professor Dittrich's laboratory, in Germany, and is published in a paper by Dr. Paul, of Sydney, in Tschermak's Min. u. Petr. Mitteilungen (Vienna, 1906).

Dr. Paul enumerates the constituent minerals as labradorite felspar, pyroxene, amphibole, orthoclase felspar, and quartz (intergrown), with accessory ilmenite, apatite, and pyrite. The variety is referred by him to the Konga diabase or quartz diabase occurring in Scandinavia. The analysis is as follows:—

SiO_2	56·74
TiO_2	1·26
Al_2O_3	15·46
Fe_2O_3	3·08
FeO	7·58
MnO	trace
MgO	2 54
CaO	7·64
Na_2O	3·08
K_2O	1·59
H_2O	1·28
P_2O_5	0·15
	100·40

Specific gravity, 2·906

GEOLOGICAL SURVEY BRANCH.

During the year the Government Geologist has prepared reports on the Bell Mount and Middlesex districts; on

gold, at Port Cygnet and Wheatley's Bay; on the Ma[redacted] gana gold field. These reports are appended.

He has also compiled quarterly reports on the Miner[redacted] Industry of the State for the first three quarters of th[redacted] year, when he represented that his time was so ful[redacted] occupied, and his movements in the field so hampered b[redacted] their preparation, that I was compelled to relieve him [redacted] the work, and have undertaken their compilation mysel[redacted].

For these, as well as for the special district reports, there is a considerable demand from abroad and from visitors arriving in the State. Our publications lying upon the tables of public libraries and institutes throughout the world may be regarded as of distinct service in directing the attention of investors to the mineral resources of Tasmania.

The appointment of Mr. Leonard Keith Ward to the position of Assistant Government Geologist (mentioned in the first part of this Report) will, I feel sure, not only materially strengthen this branch, but give general satisfaction to the Department and to the mining public.

Inspectors of Mines.

The three inspectors have satisfactorily discharged their duties in the districts severally allotted to them. Their reports are appended.

Mining Managers' Examination.

The annual examination of candidates for mining managers' certificates was held in March. Three candidates presented themselves for examination, and two succeeded in obtaining second-class certificates.

Diamond-drills.

The diamond-drills were not in operation during the period under review.

Mount Cameron Water-race.

The report of the board is appended.

Departmental Staff.

The only changes which took place in the staff during the year were the appointments of Mr. L. K. Ward as Assistant Government Geologist and Inspector of Mines, and Mr. E. W. Turner as Warden of Mines, Western Division, *vice* Mr. L. E. Chambers.

Revenue.

The net revenue for the year amounted to £24,794 7s. 7d., being an increase of £557 15s. 2d. on the previous year. This amount does not include the sum of £4623 12s. 9d. deposited as survey fees with applications for leases.

Conclusion.

In conclusion, I desire to thank officers of the Departmental staff for the loyal and efficient manner in which they have performed the duties allotted to them.

I have the honour to be,

Sir,

Your most obedient Servant,

W. H. WALLACE, Secretary for Mines.

The Hon. Donald Campbell Urquhart,
Minister for Mines.

DIAMOND-DRILLS.

Statement of Work done to 31st December, 1907

Year.	Locality.	Direction of Bore.	No. of Bores.	Total Distance Bored.	Average cost per foot, inclusive of Labour and Fuel.
	No. 1 Drill.			feet.	£ s. d.
1882-3	Back Creek—For Gold	Vertical	7	1330	0 10 9
1883	Lefroy—For Gold	Ditto	4	1011	0 5 3
1884	Tarleton—For Coal	Ditto	1	401	0 5 6
1886	Longford—For Coal	Ditto	2	1585	0 4 0½
1886-7	Harefield Estate—For Coal	Ditto	1	725	0 6 5
1887	Cardiff Claim, Mount Malcolm—For Coal	Ditto	1	562	0 17 11¾
1888	Killymoon Estate—For Coal	Ditto	1	504	0 4 7¾
1888-9	Seymour—For Coal	Ditto	5	2266	0 7 8½
1889 / 1890	Beaconsfield (Phœnix G.M. Co.) For Gold	Ditto	1	781	2 0 2
1890	Beaconsfield (East Tasmania G.M. Co.)—For Gold	Ditto	1	978	0 14 9½
1891	Spring Bay—For Coal	Ditto	4	937	0 6 10
1891	Ravensdale—For Coal	Ditto	1	114	0 11 1½
1891-2	Back River, Prosser's Plains—For Coal	Ditto	2	854	0 6 1¾
1892-3	Lefroy (Deep Lead Syndicate)—For Gold	Ditto	4	979	0 15 9
1893	Lefroy (East Pinafore Co.)—For Gold	Ditto	1	317	0 10 3
1895-6	Sandfly—For Coal	Ditto	4	2130	0 11 5
1898 / 1900	Blue Tier (Anchor Co.)—For Tin	Ditto	9	876½	0 9 1¾
1901-2	Llandaff—For Coal	Ditto	3	1944	0 7 4
1902	Recherche (Catamaran Co.)—For Coal	Ditto	2	956	0 9 3
1903	Ditto (Moss Glen Co.)—For Coal	Ditto	2	667	0 7 6
	Total	...	56	19,917½	

1882	No. 2 DRILL. Beaconsfield—For Gold ...	Horizontal, underground	1	68	No record
1883	*Mangana—For Gold* ...	Ditto	1	546	0 15 1
1884	Guy Fawkes Gully, near Hobart—For Coal ...	Vertical	1	612	0 5 6
1885	Malahide Estate, near Fingal—For Gold ...	Ditto	5	1397	0 5 6
1886	Carr Villa, near Launceston For Coal ...	Ditto	1	571	0 5 4
1886-7	Waratah (Mount Bischoff Alluvial T.M. Co.) For Tin ...	Ditto	7	1548	0 6 1½
1887	Waratah (Mount Bischoff T.M. Co.)—For Tin ...	Ditto	7	841	0 11 8
1887	Ditto ...	Horizontal, underground	1	53	0 7 8
1888	Old Beach—For Coal ...	Vertical	1	593	Abt. 0 10 9
1888	Campania—For Coal ...	Ditto	1	600	0 7 7½
1888	Richmond—For Coal ...	Ditto	1	500	0 5 1¾
1889	Back Creek—For Gold ...	Ditto	4	787	0 8 5½
1891	Macquarie Plains—For Coal ...	Ditto	2	989	0 4 5½
1891	Jerusalem—For Coal ...	Ditto	1	344	0 4 9½
1892	Langloh Park—For Coal ...	Ditto	4	1249	0 5 3½
1893	Southport—For Coal ...	Ditto	1	612	0 5 3
1894	Zeehan (Tasmania Crown S.M. Co.)—For Silver ...	Horizontal, underground	2	319	1 0 2½
1902	Eden—For Coal ...	Vertical	2	566	1 0 7½
1902-3	Farm Cove—For Coal ...	Ditto	1	571	0 5 6
	TOTAL ...	...	44	12,766	

Aggregate number of bores ... 100
Total distance bored ... 32,683½ feet

W. H. WALLACE, Secretary for Mines.

No. 1.

RETURN showing the Quantity and Value of Gold won during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900. 1901, 1902, 1903, 1904, 1905, 1906, *and* 1907.

Year.	Quantity.		Value.
	ozs.	dwts.	£
1880	52,595	0	201,297
1881	56,693	0	216,901
1882	49,122	6	187,337
1883	46,577	10	176,442
1884	42,339	19	160,404
1885	41,240	19	155,309
1886	31,014	10	117,250
1887	42,609	3	158,533
1888	39,610	19	147,154
1889	32,332	13	119,703
1890	20,510	0	75,888
1891	38.789	0	145,459
1892	42,378	0	158,917
1893	37,687	0	141,326
1894	57,873	0	217,024
1895	54,964	0	206,115
1896	62,591	0	237,574
1897	77,131	0	296,660
1898	74,233	0	291,496
1899	83,992	0	327,545
1900	81,175	0	316,220
1901	*69,491	0	295,176
1902	*70,996	0	301,573
1903	*59,891	0	254,403
1904	*65,921	0	280,015
1905	*73,540	10	312,380
1906	*60,023	8	254,963
1907	65,354	5	277,607
	1,530,676	2	6,030,671

* Fine Gold.

Diagram showing Total Quantity & Value of Gold won in Tasmania during the years 1880-1907

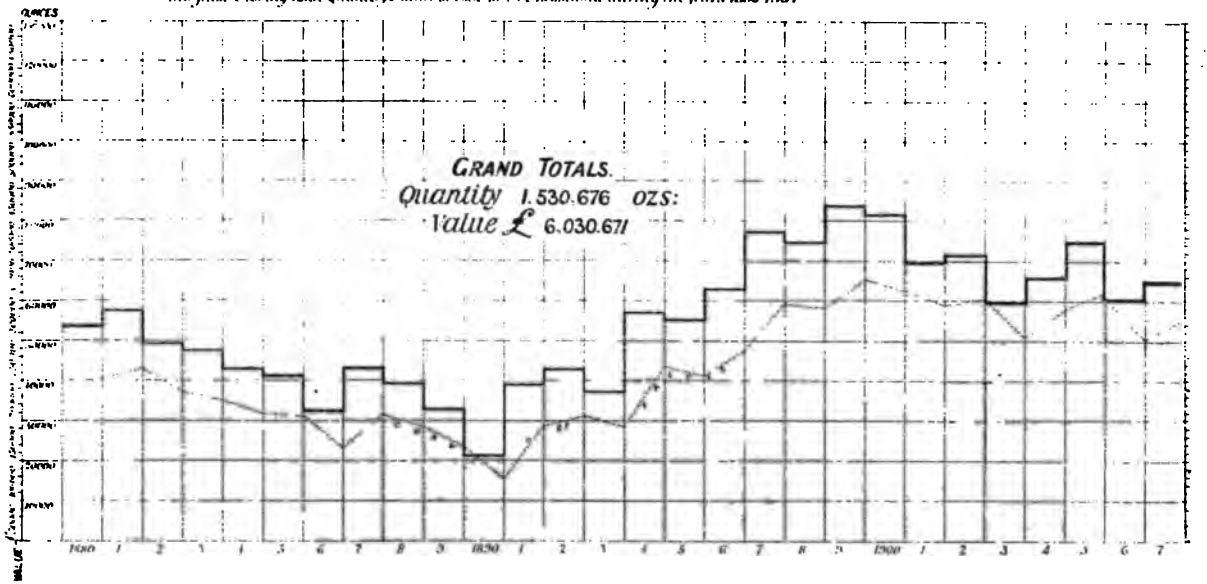


Photo Algraphed by John Vail Government Printer Hobart Tasmania

Diagram showing Total Quantity & Value of Coal mined in Tasmania during the years 1880-1907

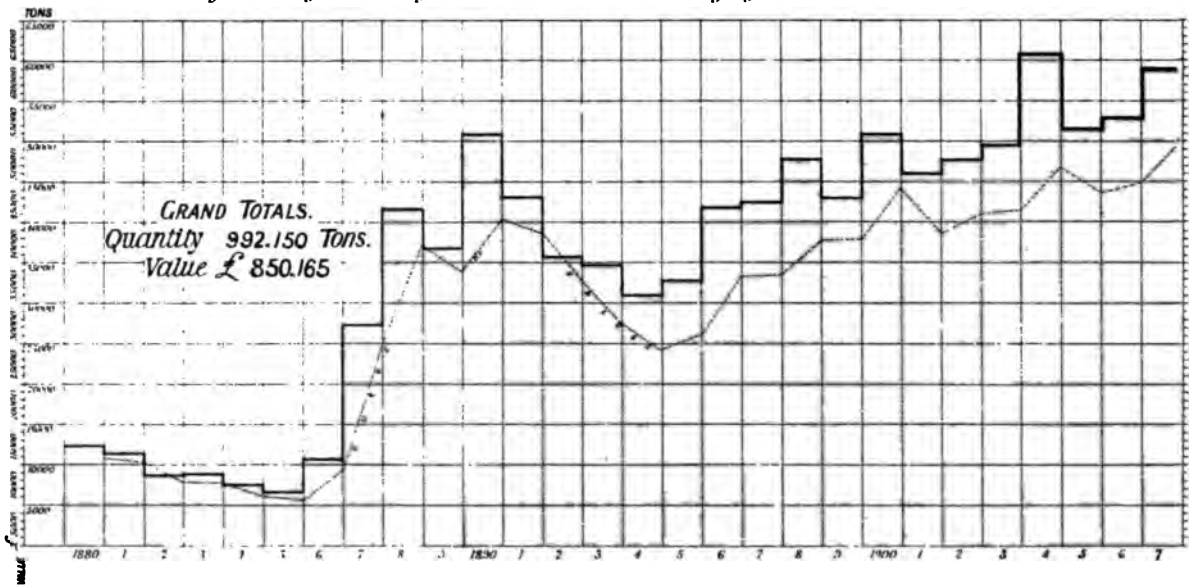


Plate Struck off by the Vice Government Printer Hobart Tasmania

No. 2.

***RETURN** showing the Quantity and Value of Coal raised during the Years* 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, *and* 1907.

Year.	Quantity.	Value.
	Tons.	£
1880	12,219	10,998
1881	11,163	10,047
1882	8803	7923
1883	8872	7985
1884	7194	6475
1885	6654	5989
1886	10,391	9352
1887	27,633	24,870
1888	41,577	37,420
1889	36,700	33,030
1890	50,519	45,467
1891	43,256	38,930
1892	36,008	32,407
1893	34,693	27,754
1894	30,499	24,399
1895	32,698	26,159
1896	41,904	33,523
1897	42,196	33,757
1898	47,678	38,256
1899	42,609	38,349
1900	50,633	44,227
1901	45,438	38,451
1902	48,863½	41,533
1903	49,069	41,709
1904	61,109	51,942
1905	51,993	44,194
1906	52,895¾	44,962
1907	58,891	50,057
	992,150¼	850,165

No. 3.

RETURN showing the Quantity and Value of Tin exported from Tasmania during the Years 1880, 1881. 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, *and* 1904, *compiled from Customs Returns only, and Tin Ore produced during the Years* 1905, 1906, *and* 1907.

Year.	Quantity.	Value.
	Tons.	£
1880	3954	341,736
1881	4124	375,775
1882	3670	361.046
1883	4122	376,446
1884	3707	301,423
1885	4242	357,587
1886	3776	363.364
1887	3607½	409,853
1888	3775¼	426.321
1889	3764	344,941
1890	3209¼	296,368
1891	3235	291,715
1892	3174	290,083
1893	3128½	260,219
1894	2934	198.298
1895	2726¾	167,461
1896	2700	159,036
1897	2423½	149,994
1898	1972	142.046
1899	2239¼	278,323
1900	2029	269,833
1901	1789½	212,542
1902	1958¼	237,828
1903	2376$\frac{3}{10}$	300,098
1904	2171½	255,228
1905*	3891½	362,670
1906*	4472¾	557,266
1907*	4342¾	501,681
	89,515⅔	8,589,181

* Tin Ore produced : Customs having ceased to issue Returns.

Diagram showing Total Quantity & Value of Tin exported from Tasmania during the years 1880-1904 and Tin ore produced during the years 1905 and 1907

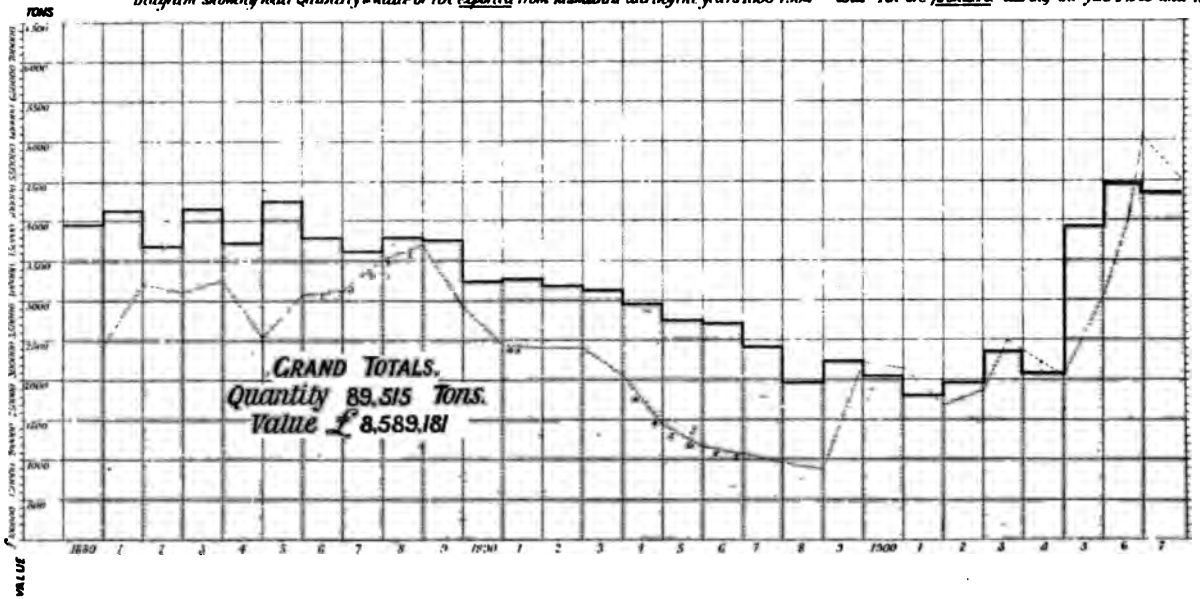


Photo Mgraphed by John Vail Government Printer Hobart Tasmania

No. 4.

RETURN showing the Quantity and Value of Silver-Lead Ore produced during the Years 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, *and* 1907.

Year.	Quantity.	Value.
	Tons.	£
1888	417	5838
1889	415	7044
1890	2053	26,487
1891	4810	52,284
1892	9326	45,502
1893	14,302	198,610
1894	21,064	293,043
1895	17,980	175,957
1896	21,167	229,660
1897	18,364	200,167
1898	15,320	188,892
1899	31,519½	250,331
1900	26,564	279,372
1901	28,774	207,228
1902	46,480	218,864
1903	42,422	192,492
1904	51,138	203,702
1905	75,270½	246,888
1906	87,117¾	462,443
1907	89,762½	572,560
	604,266¼	4,057,364

No. 5

RETURN showing the Quantity and Value of Blister Copper produced during the Years 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, *and* 1907.

Year.	Quantity.	Value.
	Tons.	£
1896	41½	1245
1897	4700	322,500
1898	4955½	400,668
1899	8598	735,305
1900	9449	907,288
1901	9981	879,625
1902	7745	*462,151
1903	6684	*478.023
1904	8371	*582.540
1905	8610	*704,287
1906	8708	*862,444
1907	8247	*832,691
	86,090	7,168,767

* Value of Gold contained deducted.

No. 6.

RETURN showing Quantity and Value of Copper Matte exported during the Years 1902, 1903, 1904, 1905, 1906, *and* 1907.

Year.	Quantity.	Value.
	Tons.	£
1902	2500	50,112
1903	3727	83,624
1904	—	—
1905	—	—
1906	—	—
1907	—	—
	6227	133,736

No. 7.

RETURN showing the Quantity and Value of Copper Ore produced during the Years 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, *and* 1907.

Year.	Quantity.	Value.
	Tons.	£
1896	34	1020
1897	75	2250
1898	394	8128
1899	1695	26,833
1900	4221½	63,589
1901	11,221	130,412
1902	5994	65,270
1903	102	790
1904	104	1640
1905	1150¾	52,939
1906	2234½	72,480
1907	788¼	36,975
	28,014	462,326

No. 8.

RETURN showing the Quantity and Value of Iron Ore produced during the Years 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, *and* 1907.

Year.	Quantity.	Value.
	Tons.	£
1897	894	812
1898	1598	1598
1899	3577	3474
1900	5375	5995
1901	612	417
1902	2386	1075
1903	5980	2905
1904	6840	2975
1905	6300	2600
1906	2600	1100
1907	3000	1150
	39,162	24,101

No. 9.

RETURN showing the Quantity and Value of Asbestos produced during the Years 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, *and* 1907.

Year.	Quantity.	Value.
	Tons.	£
1899	200	363
1900	128	113
1901	46½	45
1902	—	—
1903	—	—
1904	—	—
1905	—	—
1906	—	—
1907	—	—
	374½	521

No. 10

RETURN showing the Quantity and Value of Wolfram produced during the Years 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, *and* 1907.

Year.	Quantity.	Value.
	Tons.	£
1899	3½	99
1900	53¾	2058
1901	—	—
1902	—	—
1903	—	—
1904	15½	1147
1905	32¼	2371
1906	19¾	1465
1907	40¾	4411
	165½	11,551

No. 11.

***RETURN** showing the Quantity and Value of Bismuth produced during the Years* 1904, 1905, 1906, *and* 1907.

Year.	Quantity.	Value.
		£
1904	6 cwt.	15
1905	3½ tons	800
1906	6 cwt.	24
1907	3½ cwt.	27
	4 tons 5½ cwt.	866

No. 12.

***RETURN** showing the Quantity of Silver-Lead and Copper Ore smelted for period 25th June to 31st December,* 1896, *and 1st January* 1897, *to 31st December,* 1907.

Year.	Ore Smelted.	Products.			Yield.			
		Silver-Lead Bull'n.	Blister Copper.	Matte.	Copper.	Silver.	Gold	Lead.
	Tons.	Tons.	Tons.	Tons.	Tons.	Ozs.	Ozs	Tons.
1896	26,028$\frac{13}{20}$	—	—	2417$\frac{6}{20}$	1235$\frac{1}{20}$	75,951	4707	—
1897	90,773½	—	3476$\frac{13}{20}$	257$\frac{16}{20}$	3583$\frac{14}{20}$	334,349	16,485	—
1898	170,933	—	4992	—	4783	606,123	24,418	—
1899	275,239	2295	8463	89$\frac{6}{20}$	8362	1,089,657	27,615	—
1900	363,113	4817	9449	—	9341	1,215,036	26,255	—
1901	355,528	1839	9982	50	9880	800,317	21,717	—
1902	411,736	6825	7727	2882	8841	1,674,816	24,719	6654
1903	399,032	7560	6683	3413	8094	1,855,158	25,238	7529
1904	433,366	—	8371	—	8265	1,896,134	26,809	7754
1905	466,578	9422	8611	—	8596	2,075,431	26,469	9086
1906	479,775	9380	8768	—	8613	2,150,405	24,986	9300
1907	472,658	10,590	8248	—	8145	2,147,120	24,531	10,060

No. 13.

RETURN showing the Average Number of Persons engaged in Mining during the Years 1880 *to* 1907 *inclusive.*

Year.	Number.	Year.	Number.
1880	1653	1894	3433
1881	3156	1895	4062
1882	4098	1896	4350
1883	3818	1897	4510
1884	2972	1898	6052
1885	2783	1899	6622
1886	2681	1900	7023
1887	3361	1901	6923
1888	2989	1902	5934
1889	3141	1903	6017
1890	2868	1904	6194
1891	3219	1905	6581
1892	3295	1906	7005
1893	3403	1907	7516

No. 14.

RETURN showing the total Area of Land and Number of Sluiceheads of Water applied for during the Year ending 31*st December*, 1907.

Mineral.	No. of Applications.	No. of Sluiceheads.	Area.
			Acres.
Asbestos	1	...	10
Coal	5	...	470
Copper	95	...	5800
Galena	12	...	750
Gold	96	...	1386
Iron	8	...	360
Minerals	234	...	11,900
Manganese	1	...	80
Nickel	1	...	80
Silver	49	...	2461
Slate	2	...	340
Scheelite	2	...	160
Tin	242	...	5845
Zinc-Lead	1	...	40
Machinery Sites	10	...	68
Dredging Claims	11	...	104
Water-rights	158	891	136
TOTAL	928	891	29,990

No. 15.

RETURN showing the total Number and Area of Leases issued during the Year ending 31st December, 1907.

Mineral.	Number.	Sluiceheads.	Area.
			Acres.
Bismuth	1	...	40
Coal	9	...	2758
Copper	38	...	2900
Gold	84	...	1056
Iron	1	...	80
Minerals	152	...	9486
Nickel	1	...	80
Silver-Lead	26	...	1632
Shale	4	...	740
Tin	394	...	11,352
Wolfram	1	...	120
Machinery Sites	6	...	30
Mining Easements	27	...	121
Dredging Claims	32	...	576
Water-rights	116	506	284
	892	506	31,255

No. 16.

RETURN showing the Total Number of Leases in force on 31st December, 1907.

Mineral.	Number.	Sluiceheads.	Acres.
			Acres.
Bismuth	1	...	40
Coal	29	...	5182
Copper	56	...	3089
Gold	222	...	2671
Iron	11	...	528
Limestone	4	...	383
Lithographic Stone	1	...	97
Minerals	256	...	16,767
Marble	1	...	317
Nickel	6	...	180
Phosphate of Lime	1	...	3
Precious Stones	1	...	80
Silver	172	...	9850
Slate	1	...	200
Shale	8	...	1780
Tin	1333	...	33,961
Wolfram	8	...	552
Machinery Sites	35	...	123
Mining Easements	75	...	496
Dredging Claims	79	...	1494
Water Rights	490	1978	1430
	2790	1978	79,163

No. 17.

RETURN showing the Average Number of Miners employed during the Year ending 31st December, 1907.

	Europeans.	Chinese.
Northern and Southern Division	894	—
North-Eastern Division	884	94
Eastern Division	650	34
North-Western Division	607	...
Western Division	4353	...
	7388	128

No. 18.

RETURN showing the Number and Area of Leases held under "The Mining Act," in force on 30th June in Years 1901 to 1903 inclusive, and on 31st December, 1903, 1904, 1905, 1906, and 1907.

Nature of Lease.	In force on 30th June, 1901.		In force on 30th June, 1902.		In force on 30th June, 1903.		In force on 31st December, 1903.		In force on 31st December, 1904.		In force on 31st December, 1905.		In force on 31st December, 1906.		In force on 31st Dec., 1907.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.
		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.
For Minerals, Silver, Tin, &c.	1388	60,865	1063	45,399	950	40,068	826	33,325	868	33,824	944	34,325	1307	43,036	1844	65,047
For Coal, Slate, Shale, &c.	55	7566	52	7819	66	10,767	54	9119	47	7546	45	7185	35	6025	45	7962
For Gold	566	6091	425	4166	310	3117	243	2505	222	2268	195	2087	167	1836	222	2671
Dredging Claims	—	—	—	—	—	—	15	124	29	469	51	1196	91	2027	79	1494
Mining Easements	—	—	—	—	—	—	34	225	39	234	45	282	47	298	75	436
Water-rights Mineral and Gold	267	1318 sluice-heads	300	1691 sluice-heads	299	1514 sluice-heads	281	1460 sluice-heads	346	1495 sluice-heads	251	1477 sluice-heads	391	1606 sluice-heads	490	1978 sluice-heads

No. 19.

RETURN showing the Amounts paid in Dividends by Mining Companies during the Year ending 31st December, 1907.

Mines.	Dividends.
	£ s. d.
Copper	330,000 0 0
Gold	...
Tin	195,452 0 0
Silver	90,637 0 0
TOTAL	£616,089 0 0

No. 20.

RETURN showing the total Amount of Rents, Fees, &c., received by the Mines Department during the Year ending 31st December, 1907.

Head of Revenue.	Amount.
	£ s. d.
Rent of Auriferous and Mineral Land	22,283 14 3
Fees, ditto ditto	2510 13 4
Survey Fees	4623 12 9
TOTAL	£29,418 0 4

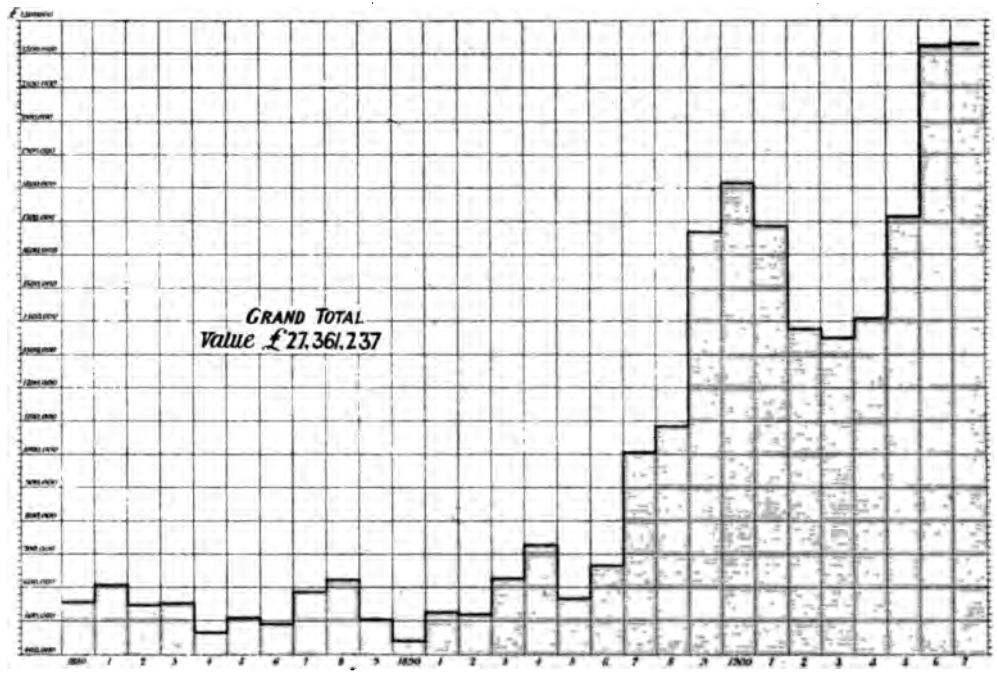
No. 21.

RETURN showing the Mining Companies registered during the Year ending 31st December, 1907.

Number of Companies.	Capital.
24	£108,970

In addition to the above, 23 Agents for Foreign Companies and 7 Syndicates, under 60 Vict. No. 51, were registered.

Diagram showing the Annual Value of Minerals & Metals raised in Tasmania from 1880-1917



No. 22.

RETURN showing Quantity and Value of Minerals and Metals raised in Tasmania from 1880 *to* 1907 *inclusive.*

Mineral or Metal.	Quantity.	Value.
		£
Gold	1,530,676 ozs.	6,030,671
Silver-lead ore	604,266 tons*	4,057,364
Blister Copper	86,090 ,,	7,168,767
Copper and Copper Ore	28,014 ,,	462,326
Copper Matte	6227 ,,	133,736
Tin	89,515 ,,	8,589,181
Iron Ore	39,162 ,,	24,101
Coal	992,160 ,,	850,165
Wolfram	165 ,,	11,551
Bismuth	4¼ ,,	866
Asbestos	374 ,,	521
Unenumerated prior to 1894...	...	31,988
Total	...	£27,361,237

No. 23.

COMPARATIVE Statement of Revenue from Mines, being Rents, Fees, &c. (exclusive of Survey Fees), paid to the Treasury for the Years ending 30th June, from 1880 to 1903, and for Six months ending 31st December, 1903, and for the Years ending 31st December, 1904, 1905, 1906, and 1907.

Year.	Amount.			Year.	Amount.		
	£	s.	d.		£	s.	d.
1880	8944	5	11	1895	15,323	1	9
1881	20,936	5	5	1896	20,901	13	2
1882	23,077	1	9	1897	25,631	0	3
1883	15,439	14	5	1898	33,661	13	9
1884	6981	11	10	1899	24,696	10	5
1885	11,070	5	7	1900	28,380	11	10
1886	12,523	10	4	1901	21,569	5	2
1887	14,611	11	5	1902	19,471	0	1
1888	23,502	8	4	1903	17,776	14	3
1889	17,254	9	0	1903, 1 July to 31 Dec.	14,758	17	1
1890	26,955	4	9	1904, Jan. to Dec.	16,631	8	2
1891	37,829	16	5	1905	20,208	17	0
1892	17,568	18	4	1906	24,136	12	5
1893	16,971	9	2	1907	24,794	7	7
1894	16,732	7	7				

The above Statement does not include Stamp Duties upon Transfer of Leases and Registration of Companies, nor the Tax payable upon Dividends, from which sources large sums are derived.

REPORT OF THE MOUNT CAMERON WATER-RACE BOARD FOR THE YEAR ENDING 31ST DECEMBER, 1907.

6th February, 1908.

SIR,

WE have the honour to submit the report of the Board for the year ending 31st December, 1907.

No. 4 Syphon.—The work of renewing this syphon was taken in hand by the Board, and instructions were issued to the Engineer in Charge to effect a survey of the route, and submit plans and specifications for consideration. Tenders were invited for the supply of 3125 feet of steel piping, 30 inches in diameter by ⅛ of an inch in thickness, and the tender of Mephan Ferguson, of Victoria, was accepted. There being no plates of a suitable size obtainable in the Commonwealth, delay has been caused through having to import them from America. The contractor has the work well in hand, and has undertaken to deliver the pipe at Boobyalla by the end of the present month. Everything is in readiness for laying the column, which will not occupy more than two or three weeks after the arrival of the pipes on the ground.

No. 5 Syphon.—In response to the Board's request, the Government placed a further sum of £4000 upon the estimates last session of Parliament for the renewal of No. 5 syphon, and the Engineer is now engaged preparing his plans and specifications to enable the Board to call for tenders at an early date.

Water.—The quantity of water available during the year was sufficient for all requirements.

Syphons.—The breaks in syphons Nos. 4 and 5 have been as frequent as heretofore, and it is only owing to the constant attention of the Manager and Channel-keepers that they have been prevented from totally collapsing. The cost of all repairs to the pipes has been £74 18s. 9d., but when the new No. 4 syphon is erected there will be no further expense in this direction for iron bands, as there will be hundreds of them available on that syphon which can be utilised for the other syphons.

Flumings.—Flumings Nos. 3, 5, and 7 have been replaced by rock cuttings and embankments, and No. 13 was commenced, but had to be suspended owing to the falling off of the receipts for the sale of water, out of which such repairs are paid for. Directly the revenue is available this work will be completed, as it is of a very urgent character.

Water.—The quantity of water supplied to the customers during the year was 1934¼ sluiceheads, and the quantity of tin ore raised was 48 tons 0 cwt. 1 qr. 12 lbs., as against 94 tons 7 cwts. 1 qr. 23¼ lbs. last year. The decrease in the quantity of tin ore raised is mainly owing to the closing down of the Scotia and Cybele Tin Mines, and the fact of large areas of tin ground commanded by the race having been held and locked up by single companies; but as some of these areas have recently been

forfeited, small areas may be taken up again by smaller companies or co-operative parties.

The revenue amounts to £956 12s. 9d., being a decrease of £1879 5s. 2d. as compared with the previous year.

The Engineer in Charge has furnished the Board with details of the work performed during the year.

Statistics for the year are as follows:—

Average per week of claims supplied, 12.

Greatest number supplied in any one week, 18.

Total number of heads supplied—

Under fixed or cash scale	657½
Under royalty or credit scale... ...	1296½
Total	1954½

Tin ore raised for the year:—Royalty scale, 16 tons 2 cwts. 1 qr. 12 lbs.; fixed scale, 31 tons 2 cwts.; total, 48 tons 0 cwt. 1 qr. 12 lbs.

Average number of men employed per week, 28.

Total receipts for the year:—Water sold, fixed scale, £521 3s. 5d.; water sold, royalty scale, £420 11s. 5d.; other receipts, sale of asphaltum, &c., £14 17s. 11d.; total, £956 12s. 9d.

Expenditure.—Cost of maintenance and management:—

	£ s. d.	£ s. d.
Salary and wages...	603 18 0	
Repairs to syphon pipes...	74 18 9	
Repairs to flumings	42 11 8	
Travelling expenses	21 12 10	
Stores and tools	35 7 7	
Stationery and printing	6 6 0	
Insurance	3 6 0	
		788 0 10
Renewal of flumings	...	948 14 0
No. 4 syphon (6 Edw. VII. No. 23)	...	867 12 9
Completion of overflow-channel at intake, &c.	...	78 9 9
Total	...	£2682 17 4

W. H. WALLACE, Chairman.
W. H. TWELVETREES,
EDWARD L. HALL,
JOHN SIMPSON,
S. HAWKES,
Members of the Board.

The Hon. the Minister for Mines.

MINE MANAGERS' EXAMINATION.

MARCH 24TH, 1908.

SUBJECT—MINING.

1. Describe the different methods of driving in running ground.
2. Describe, with sketches, a rock-drill.
3. Describe the ordinary explosives used in mining, and for what special purposes would you use each, and what precautions would you take in using them.
4. What would you consider the most economical method of removing 1,000,000 cubic yards of overburden 100 feet deep, consisting of partly decomposed basalt containing boulders up to a ton weight? Describe the methods and the plant you would use.
5. Describe the methods and appliances used in a hydraulic-sluicing mine.
6. You are required to work a deep alluvial gold lead with much water in it. Describe, with sketches, how you would set about it.
7. A mine has been opened up to a depth of 150 feet, and there is a daily flow of 30,000 gallons of water, of which ¼ is making in the sump. What size of pump would you put in to allow opening up to a depth of 500 feet? What size of shaft would you require? Show by sketches how you would place the pitwork in the shaft. Assume various conditions.
8. Describe in detail the method you would adopt for signalling in a shaft at present 500 feet deep, and which, in addition to an output of 100 tons a day, has to be sunk 100 feet a year in wet ground.
9. A lode, dip about 60 degrees, varies in width from 3 to 6 feet, and is payable throughout. Describe how you would stope it out, and at what vertical distances apart you would place your levels—
   (1) With good standing walls;
   (2) With bad standing walls.
10. Describe the safety appliances you consider necessary in connection with winding from mines, and how you would test winding-ropes and connect them to winding-engine and cage.
11. A drive on a lode is timbered with 12-inch timber; a stope is being brought up below it. How would you pick up the level—
   (1) In good ground;
   (2) In heavy ground.

   Give sketches.
12. Describe the various machines and appliances used in connection with the ventilation of deep mines, and methods of distributing fresh air to the various working faces.

SUBJECT—ORE-DRESSING AND SAMPLING.

1. Describe a canvas table. What are its advantages and disadvantages?
2. Compare a jaw-breaker with a gyratory-breaker. Which would you prefer, and why?
3. Describe a system of sampling from the faces of a quartz mine to the tail-race, to obtain the value of the ore in the mine, to test the different appliances in the battery, and to test the saving of the battery as a whole.
4. Describe the appliances you would use in a concentrating plant to treat 20 tons of silver-lead ore per 8 hours when the ore is in coarse and fine particles through the gangue.
5. How would you sample a shipment of 20 tons of black tin?
6. Describe in detail a machine for treating coarse sand containing 5 per cent. of—
   (1) Iron pyrites;
   (2) Galena;
   (3) Cassiterite;
   and state what percentage of the contents you would expect to save in each case, and what weight of concentrates you would obtain from 100 tons treated.

SUBJECT—MINING GEOLOGY.

1. Explain briefly the various theories which claim to account for the filling of metalliferous veins.
2. Define the terms—
   Zone of Oxidation;
   Vadose Circulation;
   Barysphere.
   Give the chief ores of silver, lead, copper, and zinc existing at depth and those usually met with near the surface, accounting for the presence of the latter.
3. Describe briefly the development of methods for the recovery of faulted veins, and illustrate present-day methods by an example.
4. Give any examples of secondary enrichment you know of, with your explanation of the occurrences.
5. Give any examples you can of the effect of wall-rock on the metallic contents of lodes.
6. What do you understand by the terms slickensides and flucan, and what class of vein do they usually indicate? Give examples; *or* give examples of banded structure with your explanation of its formation.
7. Describe any system of deep leads with which you are acquainted, and discuss the probable source of metallic contents as a guide to exploitation.

SUBJECT—MINING SURVEYING.

1. Describe the usual methods of ascertaining horizontal distances in surveying.
2. Give field notes of the survey of a mine with a main shaft and two levels, as required annually by the Mines Department.

3. In selecting a theodolite, what would be the principal points of construction to which you would pay attention, and how would you test them?
4. Describe carefully the adjustment of the transit theodolite.
5. Describe the level, and the precautions you would take in using it to ensure accurate work.
6. A winze is sunk on a vein of varying underlie. Describe your method of survey, and give field notes.
7. The tangents of a 10-chain curve include an angle of 120°. Shew how to set the curve out by offsets and deflection angles, giving the necessary calculations.
8. In a certain traverse, it is impossible to measure the lengths of two sides not contiguous, but their bearings and lengths of other sides and bearings are obtained. Shew how you would obtain by latitude and departure the length of the sides and area of figure.
9. Describe any method of ascertaining the True Meridian.

SUBJECT—SURFACE WORK.

1. Give sketch designs of a trestle bridge 30 feet high for a train of mine trucks.
2. Give sketch plan of an ore-bin to hold 100 tons of quartz.
3. Give sketches showing pit-head gear for a self-dumping skip in a vertical shaft.
4. In designing a water-pipe for a power scheme, do you consider it wise to have large pipes at the top of the column and smaller ones at the bottom?
   Give your reasons in the following cases: —
   (*a*) A column everywhere under a low head;
   (*b*) A, say 30" column, for first 200 feet under 60-feet head, and for last 1000 feet under head rapidly increasing to 600 feet.
5. How would you make comparisons between the motive-powers for machinery of a large mine in a locality where fuel is fairly cheap and inexhaustible, and water-power may be obtained at considerable initial cost?
6. Two steel plates, each ⅞-inch thick, are lap-jointed and rivetted together by two rows of ¾-inch steel rivets, the pitch being 3 inches, and the rows 1¾ inches apart. What is the least percentage of strength of the joint?
7. If a water-pipe be made with joints as in the previous question, and is 36 inches internal diameter, what head of water would it safely carry?
8. Neglecting friction and the weight of the lever and valve, what proportions must exist between the different parts of a safety-valve of the lever and ball type in order that the addition of each pound weight on the end of the lever just balances an increase of one pound pressure in the boiler?
9. What would be the indicated horse-power of a single-cylinder high-pressure steam-engine having a cylinder 20 inches in diameter by 36 inches stroke: revolutions, 60 per minute; average pressure throughout the stroke, 30 lbs. per square inch? What brake-horse power would you expect from the above engine?
10. The lower end of a water-pipe 600 yards long from a reservoir is under a head of 115 feet. For the first, or

upper, 400 yards this pipe has an internal diameter of 6 inches; at the lower end of the pipe a jet 1¼ inches in diameter discharges 227 gallons per minute. What is the smallest diameter of the lower 200 yards of the pipe?

SUBJECTS—ARITHMETIC, MENSURATION, AND MINING ACCOUNTS.

1. Find the value of

$$\frac{(3\frac{1}{4} - 2\frac{1}{2}) \div \frac{1}{8} \text{ of } \frac{1}{8}}{2\frac{3}{8} \div (\frac{1}{4} + \frac{1}{4})}$$

and express the result as a decimal.

2. Two cog-wheels work together, one having 360 teeth and the other 100. If the first revolves 20 times in one minute, how many times will the second revolve in an hour? And if the latter turns a drum whose circumference is 5 feet, how many miles of thread will it wind upon the drum in a working-day of 11 hours?
3. Find the number of tons of firewood contained in a stack of the following dimensions:—Bottom length, 90 feet 6 inches; top length, 45 feet 9 inches; height, 10 feet; in 5-feet lengths; reckoning 50 cubic feet per ton.
4. Find the dividend on £6894 13*s.* 4*d.* at 1*s.* 3*d.* in the £.
5. Four men dig a trench in 15½ days working 10 hours per day each. Supposing them to have worked 8 hours a day, how many days would they have occupied?
6. Describe the books and form of accounts which you consider desirable for controlling the receipts and distribution of stores.
7. Name, describe, and give illustrations of the accounts and statistical returns which a mining manager might be expected to send in monthly to the head office.

SUBJECT—MINING LAW.

All questions are required to be answered.

1. How would you neutralise the fumes arising from an explosion of nitro-glycerine which cannot be effectively disposed by ventilation?
2. How should cages be covered for protection to persons ascending or descending shaft?
3. At what angle should ladders be placed in a shaft for the convenience of miners? What space should be allowed between the rungs of such ladders; and what space must be allowed between the rungs and the wall?
4. What is the limited length of rope or chain ladders which may be used in a shaft during sinking operations?
5. In raising or lowering men, what is the limited rate of speed at which a cage or bucket is allowed to travel?
6. What provision is required to be made in a mine which is liable to an inundation or burst of water?

The following Lists of Certificates granted since the inception of the Board of Examiners for Mining Managers' Certificates are published in accordance with a resolution passed at the Interstate Conference of Boards of Examiners held in Melbourne in March, 1906 :—

SERVICE Certificates of Competency granted by the Board of Examiners.

No. of Certificate.	Name.	Date of Certificate.
1. 92	Davies, Joseph	28 Sep. 1892
2. 92	Buffon, Geo. Donald	28 Sep. 1892
3. 92	Sinclair, George Peace	28 Sep. 1892
4. 92	Heighway, John Felton	28 Sep. 1892
5. 92	Irvine, Peter	28 Sep. 1892
6. 93	Daniel, John	29 Mar. 1893
7. 93	Marshall, John Henry	29 Mar. 1893
8. 93	Aaron, Gabriel	29 Mar. 1893
9. 93	Webb, George	29 Mar. 1893
10. 94	Payne, John Greaves	3 Apr. 1894
11. 94	Wesley, William Henry	3 Apr. 1894
12. 94	Andrews, Thomas	3 Apr. 1894
13. 95	Richards, Moses John	17 Apr. 1895
14. 95	Richards, Stephen Eddy	5 Nov. 1896
15. 98	Stubs, Joseph Thomas	20 Jan. 1898
16. 98	McCrackan, John	20 Jan. 1898
17. 98	Heery, Luke	5 Mar. 1898
18. 98	Curtain, Cornelius Henry	13 Apr. 1898
19. 98	Clerk, Frederick Malcolm	14 Apr. 1898
20. 99	Craze, John	25 Jan. 1899
21. 99	Tilley, George Reynolds	17 Apr. 1899
22. 99	Hooper, Thomas Martin	17 Apr. 1899
23. 99	Vincent, Thomas	17 Apr. 1899
24. 1900	Brown, William	9 Jan. 1900
25. 1900	Rosewarne, David Davey	4 Oct. 1900
26. 1901	Buddon, William	1 Mar. 1901
27. 1901	Yeates, Alexander	29 Apr. 1901
28. 1902	Ireland, Mark	22 Apr. 1902
29. 1902	Woolcock, John	23 Sep. 1902
30. 1903	Powell, Robert William	5 May, 1903
31. 1904	Muir, John James	27 July, 1904
32. 1904	Moyle, John	5 Dec 1904
33. 1904	Ridley, John	12 Dec. 1904
34. 1906	Brough, Daniel	23 Apr. 1906
35. 1906	Berrill, Samuel	23 Apr. 1906
36. 1906	Barker, George	24 July, 1906
37. 1907	Wisch, John G. A.	6 Nov. 1907

COLLIERY Certificates of Competency granted by Board of Examiners.

No. of Certificate.	Name.	Date of Certificate.	Class of Certificate.
1. 92	Brain, Austin Lionel Bennet	28 Sep. 1902	First class
2. 1907	Wallace, Archibald Campbell	23 Apr. 1907	Second class
3. 1907	Williams, Thomas James	8 May,1907	First class

CERTIFICATES of Competency granted by the Board of Examiners.

No. of Certificate.	Name.	Date of Certificate.	Class of Certificate.
1. 92	Dunstan, Alfred John	28 Sep. 1892	First class
2. 92	Ekborg, Benjamin Pherson	28 Sep. 1892	Second class
3. 92	Hill, Charles	28 Sep. 1892	Second class
4. 92	Booth, John Robert	28 Sep. 1892	Second class
5. 92	Stapleton, Michael	28 Sep. 1892	Second class
6. 92	Lewis, Philip	28 Sep. 1892	Second class
7. 92	Hanlon, Christopher	28 Sep. 1892	Second class
8. 92	Williams, Luke	28 Sep. 1892	Second class
9. 92	Macandrew, Harold	28 Sep. 1892	First class
10. 92	Harris, William	28 Sep. 1892	First class
11. 93	Stapleton, Michael	29 Mar. 1893	First class
12. 93	Hanlon, Christopher	29 Mar. 1893	First class
13. 93	Potter, Joseph Matthew	29 Mar. 1893	First class
14. 93	Hilder, Alfred	29 Mar. 1893	Second class
15. 93	Matthews, Peter	29 Mar. 1893	Second class
16. 93	Richards, Stephen	6 Sep. 1893	First class
17. 94	Brain, Austin Lionel Bennet	3 Apr. 1894	First class
18. 94	Thorpe, Walter	3 Apr. 1894	Second class
19 95	Williams, Luke	17 Apr. 1895	First class
20. 96	Levings, Joseph Henry	6 May,1896	First class
21. 99	Goodall, Thomas Charles	14 Apr. 1899	Second class
22. 1900	Schloesser, Robert	19 May,1900	First class
23. 1900	Nicholls, Charles Berresford	19 May,1900	First class
24. 1900	Sale, William Robert	19 May,1900	Second class
25. 1900	Williams, Richard	19 May,1900	Second class
26 1900	John McPeake	1 Aug. 1900	First class
27. 1901	Sawyer, Basil	20 Feb. 1901	First class

CERTIFICATES of Competency—continued.

No. of Certificate.	Name.	Date of Certificate.	Class of Certificate.
28. 1902	Provis, John	22 Apr. 1902	First class
29. 1902	Bird, Robert Chisholm	22 Apr. 1902	Second class
30. 1902	Briggs, William Albert John	22 Apr. 1902	Second class
31. 1902	Bartlett, William Henry	22 Apr. 1902	Second class
32. 1902	Phœnix, William	22 Apr. 1902	Second class
33. 1902	Wright, Herbert E.	22 Apr. 1902	Second class
34. 1902	Craze, John	30 Apr. 1902	Second class
35. 1903	Waller, Richard Fitzarthur	5 May,1903	First class
36. 1903	Brickhill, Hector Gordon	5 May,1903	First class
37. 1903	Barker, Reginald Fredk.	5 May,1903	First class
38. 1903	Vincent, Thomas Henry	5 May,1903	First class
39. 1903	Crittendon, James Henry	5 May,1903	First class
40. 1903	Weston, Eustace Moriarty	12 Aug. 1903	First class
41. 1903	Clark, Lindesay Colin	31 Aug. 1903	First class
42. 1904	Martin, Edward Patrick	17 Feb. 1904	First class
43. 1904	Herman, Hyman	29 Apr. 1904	First class
44. 1904	Murray, Russell Mervyn	29 Apr. 1904	First class
45. 1904	More, George Allan	14 Oct. 1904	First class
46. 1905	Beamish, William Abraham	3 Jan. 1905	First class
47. 1905	Andrews. Thomas J.	1 May,1905	Second class
48. 1905	Hitchcock, William E.	1 May,1905	First class
49. 1905	Smith, George Oliver	18 July,1905	First class
50. 1906	Rockett, Hildreth Peyton	23 Apr. 1906	Second class
51. 1906	Hales, Richard Chilman	23 Apr. 1906	Second class
52. 1906	Debenham Arthur John	28 June,1906	First class
53. 1906	Coote, Charles Edward	18 Oct. 1906	First class
54. 1907	Marks, Oscar Sidney	8 Mar. 1907	First class
55. 1907	Phelan, Bernard Fredk.	23 Apr. 1907	Second class
56. 1907	Moline, Arthur Howard Pritchard	23 Apr. 1907	First class
57. 1907	Macartney, Ross Kenneth	23 Apr. 1907	First class
58. 1907	Williams, Thomas James	8 May,1907	First class

GEOLOGICAL SURVEY OF TASMANIA.

REPORT OF THE GOVERNMENT GEOLOGIST.

Geological Survey Office,
Launceston, 7th May, 1908.

SIR,

I HAVE the honour to submit my report as Government Geologist, and Mr. L. K. Ward's report as Assistant Government Geologist, for the year ending 31st December, 1907.

During the year I have prepared the following geological reports:—

1. Report on the Bell Mount and Middlesex District, 17th June, 1907.
2. Report on Gold at Port Cygnet and Wheatley's Bay, Huon River, 22nd June, 1907.
3. The Mangana Goldfield, 22nd November, 1907.
4. The Mathinna Goldfield, Part III., 13th December, 1907.

Mr. Ward is preparing a report on the Mount Farrell Mining Field, which will be issued shortly.

Bell Mount and Middlesex.

I visited this district in March. The area comprises a tract of mineral country forming the high land for 20 miles south-west from the Wilmot township.

The field in general consists of Silurian sandstone, covered in parts by basalt of Tertiary age, and penetrated by intrusions of granite, which is usually regarded as approximately of Devonian age. At Bell Mount itself, older (pre-Silurian) rocks are exposed.

The factor which controls the mineralisation of the rocks in this district is the granite. The lodes, whether occurring in the sedimentary strata or the granitic porphyry, evidently derived their metals (tin, tungsten, bismuth, molybdenum, copper, lead, gold, silver) from the granite magma.

I endeavoured to ascertain whether certain minerals could be determined as characterising certain horizons, for in that case important guidance could be furnished for prospecting, but the present relative depth of occurrence did not appear to have any decisive bearing on this point. In any case, none of the lode exposures are far from granite or granite porphyry.

The Shepherd and Murphy Mine is actively producing a mixed tin, wolfram, and bismuth ore, which is concentrated on the spot and the concentrates despatched to Launceston to undergo there a magnetic process of separation, by means of which the magnetite and pyrite are discarded, the wolfram recovered, and a tin-bismuth ore produced for export.

The All Nations Mine has a wolfram lode carrying a thin selvage of bismuth carbonate. Some surface work has been carried on, and a few tons of wolframite shipped, realising good prices; but operations are suspended for the present, pending

flotation. Several ore deposits of the tin wolfram group occur in the district, *e.g.*, Dalcoath, Sparks, Narrawa, Blocks, &c., which at present are not being worked.

The old Bell Mount gold diggings, which yielded about 4000 ozs. of gold, are now abandoned; and the Great Caledonian Mine at the top of the 5-mile rise is also a venture of the past.

The Devon Mine, with a small galena lode carrying good values of gold and silver, is working steadily. Its position in the gorge of the Dove River and its distance from a shipping port impose a heavy tax on the mineral produced. Better means of communication with the Wilmot township would seem to be imperative, if the mine is to be worked continuously.

The lodes throughout the district have been explored for the most part only in a tentative way, yet the results of work so far are encouraging. The tin-bearing porphyries and granites extend eastwards to the Forth River, and pass over to Mt. Claude, where discoveries have been made recently of tin and silver-lead ores. To the west is a wide expanse of practically unproved country. The mines in this part of the State are disadvantageously situated for getting their ores to market, and deserve all the assistance which the State can properly grant.

Port Cygnet.

In April I examined some ground taken up for gold-dredging at Wheatley's Bay, Huon River, and the gold mine of Mt. Mary at Lovett.

Alluvial gold-seeking at Lymington and Lovett was begun 30 years ago, and some lode-mining was started near Lovett about nine years since. A belt of alkaline porphyry traverses the district, and at intervals along the line of its contact with the Permo-Carboniferous strata a development of quartz and opaline silica occurs, associated with pyrites and a little visible gold.

Some of this gold has been shed into the creeks and flats, and has been recovered by alluvial workers. The whole produce of the district has been close upon 3000 ounces. This year a syndicate applied for two dredging claims—one in Wheatley's and Petchey's Bays, in the Huon River; and the other at the mouth of Forster's Rivulet, Lymington—but after some preliminary boring had been done it was felt that the propositions did not offer sufficient scope for a modern plant.

The lode mining in the district has been unsuccessful so far, although the reddish contact stone at the Mt. Mary Mine at Lovett shows specks of gold on the joint faces.

At the Livingstone Mine the quartz is poor, and what gold there is is distributed irregularly. The presence of arsenopyrite, chalcopyrite, blende, and galena in the stone is, however, a favourable indication. Quite apart from the unique plexus of alkali rocks, the occurrences at Port Cygnet are geologically interesting, as being of later origin than that of the gold quartz reefs in other parts of the island. It does not appear that the gold is at all disseminated through the porphyry. It seems to be limited to the altered rock at the contact-line between the porphyry and the Permo-Carboniferous strata, or to quartz-veins at or near the contact. The deposition is patchy, and there is no great inducement to spend much in lode-mining. Still it is quite possible that some part of the contact-line may eventually be discovered which will prove rich enough to work

Mangana.

This goldfield surrounds the small township of the same name at the base of the foothills of Ben Lomond and Tower Hill.

I made an examination of the district in July, and the report thereon was published as the first of the new series of geological survey bulletins. I found the only active mines were the Mangana Gold Reefs and the Golden Entrance.

The main shaft at the former mine has been sunk to 819 feet, but the result has been disappointing, as no quantity of stone has been raised from lower than 300 feet. Exploration to the south of the shaft would probably lead to better results, and there is in the upper levels a good deal of stone which is nearly payable, and would, if some higher-grade patches were met with, pay for raising.

The Golden Entrance Mine is being worked on tribute, on a scale which does not do justice to it.

On Buckland's Freehold some important reefs have been worked, and others are known to exist. I understand an effort is being made to resuscitate work on this ground.

The slate and sandstone strata which enclose the gold quartz reefs belong to the Ordovician system, and to the auriferous belt which runs through the gold mining districts of Mathinna, Mt. Victoria, Warrentinna, and Lyndhurst. Their northern continuation from Mangana crosses the River Lyne near its confluence with the South Esk. The present Grant's Rivulet flat at Mangana (Fingal Valley, as it is called locally) is below the fold of a former anticlinal arch, and the positions of the Mangana reef lines are probably related to the processes which were concerned in the formation of this fold in the strata.

The first discovery of alluvial gold in the island was made at Mangana in 1852, and the first gold quartz reef was also discovered here. Many of the reefs which are known on the surrounding hills were worked at one time, but operations were generally suspended as soon as poor crushings were raised.

With imperfect financing and impatience on the part of shareholders, the field lost its supporters, although some of the richest stone ever seen in Tasmania has been obtained from more than one of the reefs.

Mathinna.

In December I visited Mathinna, and examined the Scott and Pickett line of country, which is situate between the Golden Gate and Consols' line on the north-east, and the Mangana line on the south-west. The only work being carried on was at the Scott and Pickett Mine, 2¼ miles south-west of Mathinna. A shaft has been sunk 65 feet, and driving carried on on the reef. The shoot of gold-bearing stone is short, and exploratory work will have to be undertaken by the owners. There is some chance of meeting with a reef intersection in a northerly direction.

Other reefs in the vicinity are the Commercial Reef, Pride of the Hills Reef, and O'Brien's Reef. On my next visit to Mathinna parts of the district not yet embraced in the series of my reports on the field will be examined, and when the whole district is finished a general map will be prepared and issued.

Mt. Bischoff.

In August I visited the Mt. Bischoff Tin Mine at Waratah, to examine ground on the Don Hill which it was contemplated to

prospect by means of boring. I reported to you thereon. While at Waratah I examined anew the geological features of this great mine, which I dealt with in my Waratah and Corinna report of June, 1900.

At the Mount there is a hidden granite mass, which is the source of the tin, and which has communicated with the present surface by intrusive dykes of quartz porphyry. These dykes themselves contain tin ore, and are traversed by tin-bearing veins and lodes, which are chronologically subsequent to the dykes, representing, however, the after-action of the same eruptive process. The dykes have been topazised and tourmalinised in connection with the deposition of the tin ore. During the past year the large basin of the Brown Face was practically worked out, and the mine received a set-back, from which it is now recovering with the aid of new discoveries made at the main tunnel level, which it is believed will enable a good output to be maintained. No geological reason can be adduced for doubting the downward extension of the Mount Bischoff tin ore deposits to greater depths than those at which they have been worked hitherto.

Gladstone.

In my report of 1901 I mentioned that gold quartz reefs had been opened up at different times in this district, with not much success, and referred to the probability of numerous reefs being concealed at their outcrops by the widely-spread alluvial covering. On a visit to Gladstone in September this year I examined a reef 6 miles north of the township, known as the New Imperial Reef. A small shaft had been sunk on it to 25 feet, exposing an arsenical gold quartz reef giving fair results by assay. It belongs to a group of reefs in the Gladstone district in which the gold is associated with silver, arsenopyrite, galena, and zinc-blende, and which are of the type often met with in or near masses of granite. The oxidised parts of these reefs show free gold, but in depth it is generally found that most of the gold is locked up in the pyrite. A further discovery has been made in the vicinity. If, on adequately testing these reefs, any of them can be proved to be worth developing, a welcome addition will be made to our list of productive goldfields.

Back Creek.

In September I also visited the country between Lefroy and Back Creek, which comprises an area that has been very little prospected.

The quartz reefs for the most part form a series north of and parallel with those at Lefroy. Another set of reefs in the district are gossan formations, conforming in strike and dip with the strata. One of these (the H. No. 1) was found this year to carry gold at its contact with one of the quartz reefs, and has been sunk and driven upon with a view of prospecting it in depth. Some prospecting has also been carried on on other reefs in the neighbourhood.

The Back Creek alluvial leads are also being prospected by small parties, but the principal source of the gold that has been obtained from these in the past remains to be discovered. The angular form of much of the gold and quartz indicates that these have not travelled far.

Water-pollution.

In November, in company with Inspector Griffin, I visited the Brookstead estate, on St. Paul's River, in order to report to you whether the alluvial tin deposits on that property could be worked without emptying the tailings into the river.

After examining the ground, we were of opinion that it would be possible to retain the tailings, and purify the water to some extent, by allowing it to settle in reservoirs before returning it to the St. Paul's River. Discolouration of the water could not be avoided.

Iron Ore near Forcett.

In December I examined the deposit at Lewisham, near Forcett. Some work was done here 25 years ago, and the ore smelted, I believe, at works on Battery Point, Hobart. The excavation at the old quarry exposes a face 10 feet high by 100 feet in length of limonite and hematite.

The deposit rests on Permo-Carboniferous freestone, and passes into the hill to the north below a covering of basalt. The ore itself is associated with soft sandy beds, which belong either to the freestone just mentioned or to Tertiary sediments immediately below the basaltic covering. I sampled the whole face, but this included much impure ore. The cleaner parts of the sampling were assayed by Mr. W. F. Ward, Government Analyst, and yielded 50·7 per cent. metallic iron. The area which may be assumed as workable would be 100 or 150 square feet, not including what may exist below the sheets of lava.

Progress Reports.

I prepared these for the first three quarters of the year. Mining managers and companies as a rule, while anxious to see accounts of their work duly published in these reports, do not show any alacrity in furnishing statements which can be used for that purpose. This is unfortunate, as the reports are looked for and enquired after in many parts of the world.

Since 1900 I have compiled these reports uninterruptedly, but it has recently become more and more apparent that their preparation hampers my movements in the field, and consequently I have recently had to represent to you that it is impossible for me to continue them and at the same time plan my journeys effectively. It is with satisfaction that I understand that you have decided to relieve me from the work of compilation, and that the report for the December quarter is being issued from your office.

Geological Survey.

At the end of the financial year the appointment was made of Mr. Leonard K. Ward, B.E., B.A., Lecturer in Geology at the Westralian School of Mines, Kalgoorlie, as Assistant Government Geologist. I have pleasure in mentioning that the quality of Mr. Ward's work since his arrival entirely justifies his selection for this appointment.

The organisation of work on a defined basis and on a scale appropriate to our requirements has been arranged. The accomplishment of regular surveys of mining fields is being proceeded with; certain improvements have been made in our publications, and others are being planned.

The increased work has caused the question of more office accommodation to become pressing, and it will be desirable to bear this in mind when the contemplated additions to the Public Buildings are made. A room will be necessary for Mr. Ward, and one is requisite for keeping collections in, and as a working-room. A further room is urgently wanted for drafting work. At present the draftsman's table is required by three persons simultaneously, and the want of accommodation must inevitably produce delay in work.

Office.

The correspondence this year comprised 3175 letters, publications, &c., in and out. The office library has been enriched by numerous bulletins and publications received from the geological surveys and mining departments of other countries, and our reports have been forwarded to them in return. I have to acknowledge, with thanks, the receipt from the proprietors of copies of the *Launceston Examiner*, *Daily Telegraph*, *Zeehan and Dundas Herald*, *Australian Mining Standard*, *Queensland Mining Journal*, *New Zealand Mines Record*, *New Zealand Engineering and Mining Journal*, *New York Engineering and Mining Journal*, &c. A collection of ores is being prepared, by request, for Dr. E. Weinschenk, the well-known Professor of Geology in the University of Munich.

Mr. F. S. Grove is still in charge of the renewals to the Mount Cameron Water-race. Miss Higgs ceased to act as typist on the 9th November, by the automatic operation of the "Public Service Act" governing the term of service of persons employed temporarily. Her duties were discharged to my satisfaction.

I have the honour to be,
Sir,
Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

W. H. WALLACE, Esq., Secretary for Mines, Hobart.

REPORT OF THE ASSISTANT GOVERNMENT GEOLOGIST.

Launceston, 7th May, 1908.

SIR,

I HAVE the honour to present the following report on the work upon which I have been engaged during the year ending 31st December, 1907.

It was not until the end of August that I joined the Tasmanian Government Service, and I proceeded at once to the Mt. Farrell Mining Field. The examination of this important district occupied my attention until the end of November, and as a result of this fieldwork a report, together with a geological map of the area, will shortly be ready for publication.

The Mt. Farrell Field presents many points of interest to the student of mining geology, and the information gathered should prove of value in the elucidation of other problems concerning the mineral occurrences in neighbouring areas. The report in course of preparation will include some discussion of the probable mode of genesis of the lodes. The appreciation by prospectors of those facts which have been noted with regard to the sources of the metallic ores should undoubtedly result in material advantage to the State, and lead to the discovery of hitherto unknown deposits.

In addition to the presentation of the results of my observations upon the general and economic geology of the area, the report will contain a detailed account of the present condition of the mines and the operations now being carried out by the several mining companies represented on the field.

Appended is a brief summary of the salient geological features of the district.

The principal mineral-bearing area of Mt. Farrell consists of a series of schistose sedimentary rocks, with which are associated massive and schistose igneous rocks. The latter are in the main felspathic porphyries, and the schistose types derived from them are best termed "porphyroids." The ridge of Mt. Farrell itself is formed of a dense and coarse conglomerate, commonly found on the summits of the West Coast Range. Here the beds of conglomerate stand on edge, and apparently rest unconformably upon the schistose sediments.

The rock formations which constitute the foundations upon which the abovementioned series rest, hardly outcrop on the mining area. They are in all probability the quartzitic schists and mica schists of the hills lying to the east of Mt. Farrell. Under all these formations the granite of Granite Tor appears to dip, and its western extension probably exists in depth below the Farrell field.

The complex of igneous and sedimentary schists, viz., the porphyroids and slates, are tilted to a high angle by orogenic movements. The lodes of the principal producing area occur on the western flank of the mountain, and their strike is usually within a few degrees of north and south. The dip usually coincides with the dip of the divisional planes in the schists. The geological map will show clearly that the lodes have no genetic

connection with the country rocks in which they are immediately enclosed. The lode fissures extend from slate into porphyroid and into massive felspar porphyry, and the same lode type occurs in all three of these rocks. However, there are certain differences in the physical structure of the lodes, according as they occur in the slate or in the porphyroid.

The principal lode type represented is that of the sideritic lead ores. The pyritic lead type is also represented in the case of one mine. The copper deposits of the field are of less importance, and are not yet proved to be considerable in extent. These are, in my opinion, the result of local variations in the mineral content of the ore depositing solutions at the time of the filling of the lode fissures; and are probably rather the more markedly cupriferous portions of a lode which usually carries galena as the predominant metallic mineral than copper veins pure and simple. The copper pyrites associated with the galena in all of the lodes of the field is so constantly present that it constitutes the most notable character of the lead ores.

The field contains some quartz reefs, which are not in themselves metalliferous. However, they have been formed prior to the ore deposits, and the fissuring of the district subsequent to their formation has allowed some portions of the quartz bodies to be filled with lead ore. In this way one remarkable line of vughs in the quartz has been almost completely filled with galena. Iron ore is found here and there, but never in masses of any considerable size.

The whole district shows a remarkable freedom from the processes of oxidation and secondary enrichment, and hardly any gossans are to be seen. This is doubtless the result of the physiographic features, for all the mineralised area is situated upon steeply-sloping ground which is subject to the active progress of degradation.

There are several indications which point to the stanniferous granite of Granite Tor as the proximate source of the ore bodies of Mt. Farrell, and this feature brings the Mt. Farrell field into close relationship with the other mineralised areas of the West Coast.

The mines now operative are all in the early stages of their existence. The deepest workings on the field are hardly below the level of the button-grass plain cut by the Murchison and Mackintosh Rivers, and the deeper workings of the principal mine—the North Mt. Farrell Mine—show no signs of deterioration. This fact is certainly one which should afford much comfort to the managements of both this mine and others in the district.

I have the honour to be,
Sir,
Your obedient Servant,

L. K. WARD,
Assistant Government Geologist.

W. H. WALLACE, Esq., Secretary for Mines, Hobart.

EPORT OF THE CHIEF INSPECTOR OF MINES.

Chief Inspector of Mines Office,
Launceston, 30th May, 1908.

SIR,

I HAVE the honour to present my report on the inspection of mines during the year ending 31st December, 1907.

The annexed tables and diagram supply information in a tabular form relating to the number and nature of accidents which have occurred at the mines and smelting works in this State during the 12 months.

I append the annual reports prepared by the Inspectors of Mines, viz., Mr. M. J. Griffin for the Northern and Southern, Eastern and North-Eastern Divisions; Mr. James Harrison, Inspector for the Western and North-Western Divisions; and Mr. C. H. Curtain, Inspector for the Lyell District.

The number of persons employed this year in and about the mines and smelting works was 7516.

The cases of fatal injuries were 6; and non-fatal serious injuries were 64. The death rate from accident was 0·79 per thousand, compared with 0·57 per thousand in 1906, and 1·06 per thousand in 1905. It is gratifying to observe that the fatality rate keeps low.

The ratio of serious non-fatal accidents has slightly increased, but this may be due to greater strictness in registration.

The term of 14 days' disablement has been adhered to as the criterion of the seriousness of all doubtful accidents, and as this is also being observed by the inspection departments of the other States of the Commonwealth, more useful comparisons of State statistics can be made than was formerly the case. Not only does the adoption of this method lead to useful uniformity, but the seriousness of an accident is gauged thereby far better than by leaving it to the uncertain opinion of a mining manager, or to the certificate of a medical man, who probably would class an accident as serious only when it endangers life, and take no account of the time it prevents the sufferer from resuming his occupation. From an Inspector's point of view the period of disablement is the first criterion to be applied. The occasional difference which occurs between mining managers and Inspectors as to the gravity of an accident, and the difficulty of defining the term "serious injury" comprehensively, make it advisable to amend the Act by requiring all casualties to be reported, leaving the registration of accidents to be dealt with, as now, by the Department.

Several minor amendments of the Act need to be made. Suggestions have been received from various sources, which have been carefully considered and forwarded to you with recommendations.

With an increased number of men engaged in mining, the divisional Inspectors have had an unusually busy year. Inspection on the West Coast has to some extent been hampered by the arrangement which burdens the Inspectors with duties connected with the Public Works Department. Unfortunately,

official inspection cannot ensure freedom from accidents, fatal or otherwise. Examination of the reports and statistics appended hereto will show that the majority of the casualties were not due to negligence of the rules, nor even to the lack of any rules, but were either purely accidental or owing to carelessness on the part of the sufferer. These misadventures can best be diminished in number by the exercise of constant care by the mining managers and superintendents, who should vigilantly watch mining practice and guard against possible dangers. The visits of the Inspectors do not relieve managers from their responsibilities, as is often supposed, but are otherwise beneficial in inspecting the way in which work is conducted in the various mines. Dangerous practices are put down, and careful methods receive recognition. Sometimes miners are not enjoying due protection, not because the manager is unreasonable, but because the mine owners are carrying on operations too parsimoniously for the safety of workers. In such cases the Inspectors intervene, with good results.

Proceedings have been taken in cases where breaches of "The Mining Act" occurred.

I have the honour to be,
Sir,
Your obedient Servant,

W. H. TWELVETREES.
Chief Inspector of Mines.

W. H. WALLACE, Esq., Secretary for Mines, Hobart.

TABLE showing Rate per Thousand Killed and Injured in the different Divisions for the Year 1907.

Division.	Average Number of Men employed.	Number of Accidents.	Number of Persons.		Total number Killed & Injured.	Average per 1000 Killed and Injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
Northern and Southern	894	13	Nil	13	13	14·541	Nil	14·541
North-Western...	607	5	Nil	7	7	1·153	Nil	1·153
North-Eastern	978	6	3	3	6	6·134	3·067	3·067
Eastern	684	5	Nil	5	5	7·309	Nil	7·309
Western.....	4353	39	3	36	39	8·959	0·689	8·270
	7516	68	6	64	70	...	...	...

Diagram showing the ratio of fatal accidents in mines in Tasmania.

Rate per 1000 men employed.

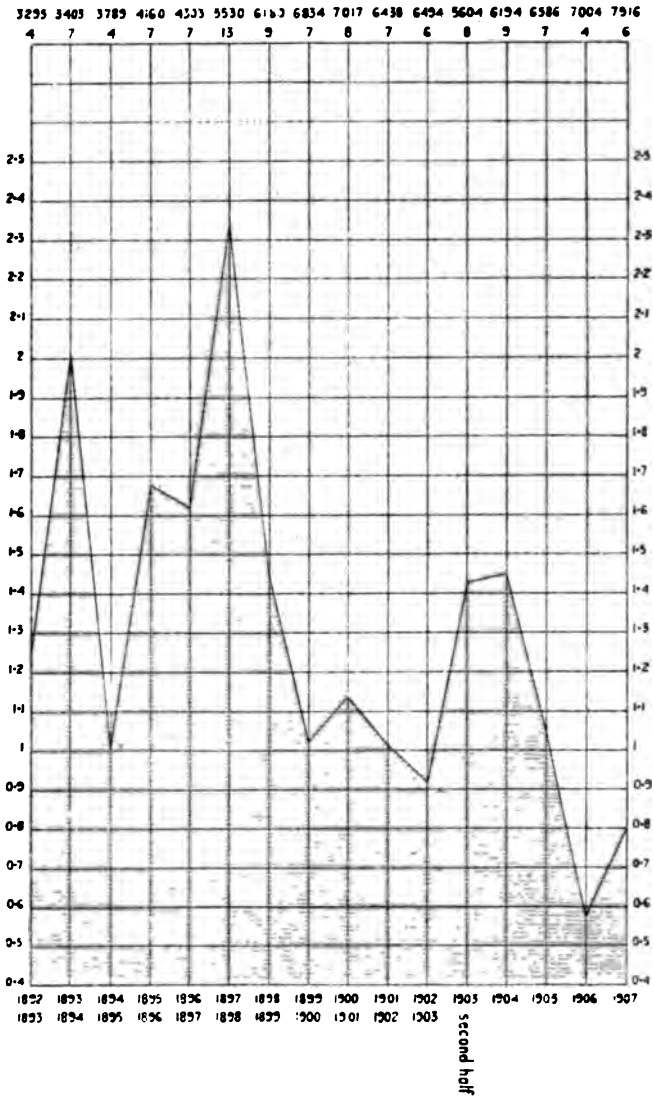


Photo Lithographed by John Vail Government Printer Hobart Tasmania

Diogram showing the ratio of fatal accidents in mines in Tasmania.

Rate per 1000 men employed.

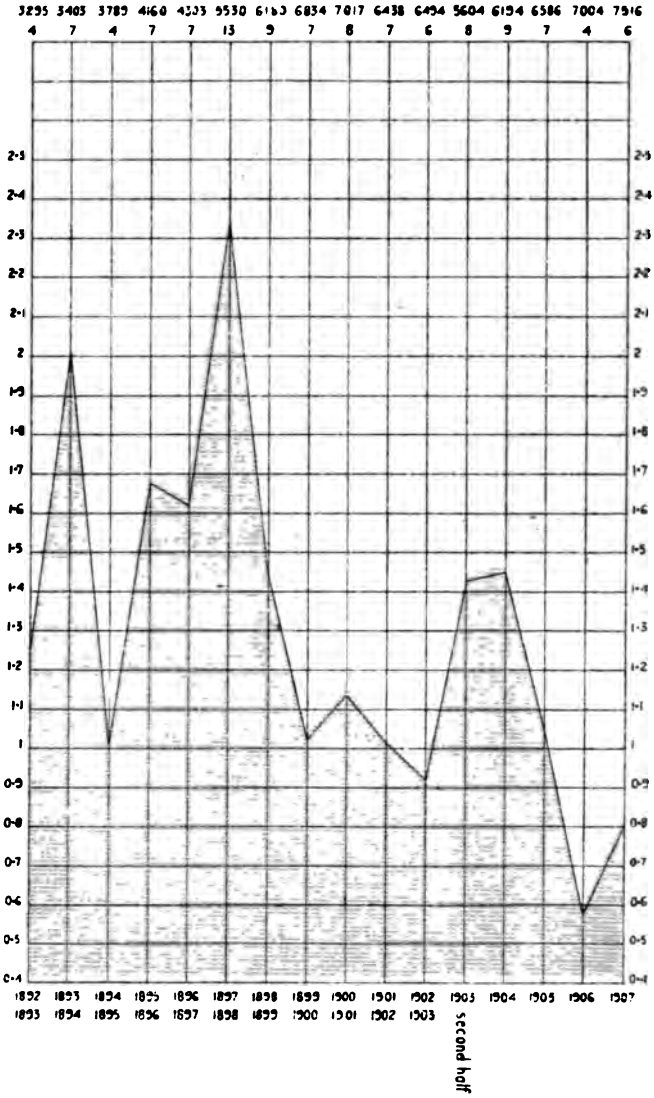


Photo Algraphed by John Vail Government Printer Hobart Tasmania

Analysis of Statistics for the Western Division.

Division.	Average Number of Men employed.	Number of Accidents.	Number of Persons.		Total Killed & Injured.	Average per 1000 Killed and Injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
Mount Lyell	2260	23	1	22	23	10·177	0·442	9·734
Zeehan, &c.	2093	16	2	14	16	7·692	0·955	6·688
	4353	39	3	36	39	8·959	0·689	8·270

TABLE showing the Number of Persons Killed and Injured in and about the Mines of Tasmania during the Year 1907.

Place or Cause of Accident.	Inspection Districts.													
	Northern and Southern Division.		North-Eastern Division.		Eastern Division.		North-Western Division.		Western Division.				Total.	
									Zeehan and other Districts.		Lyell District.			
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Underground—														
Falls of Ground	...	3	...	...	...	...	...	1	1	...	1	2	2	6
Shaft Accidents—														
Machinery	...	1	...	...	...	...	...	...	1	...	...	...	1	1
Things falling down shafts	...	1	...	...	...	...	...	...	...	...	...	1	...	2
Haulage	...	...	...	...	...	...	...	...	...	2	...	...	...	2
Falling down passes and shafts.....	...	1	...	...	...	...	...	...	...	...	...	...	...	1
Total	...	3	...	...	...	...	...	...	1	2	...	1	1	6

Haulage—														
Trams, &c.	...	2	...	...	...	...	...	...	...	...	...	...	...	2
Sundry accidents	...	1	...	...	...	...	...	...	...	...	...	...	...	1
Explosives	...	1	...	...	...	...	...	...	...	1	...	...	...	2
Total	...	4	...	...	...	...	...	...	...	1	...	...	...	5
Total Underground	...	10	...	...	...	...	...	1	2	3	1	3	3	17
ON SURFACE—														
Smelting-works	...	...	...	...	...	...	...	...	...	7	..	4	...	11
Machinery	...	4	..	...	...	1	...	4	...	...	...	4	.	13
Falls of ground	...	...	2	2	...	1	...	...	...	1	...	2	2	6
Falls of stone	...	...	...	...	...	...	...	1	...	...	...	...	...	1
Tramways	...	1	...	...	.	...	...	...	...	3	...	3	...	7
Falls of persons	...	...	...	...	...	...	. .	...	...	...	...	6	...	6
Miscellaneous—														
Guy-rope giving way	...	1	1	...	...	1	...	1	...	...	...	...	1	3
Total Surface	...	6	3	2	...	3	...	6	...	11	...	19	3	47
GROSS TOTAL, 1907	...	16	3	2	...	3	...	7	2	14	1	22	6	64
Total during 1906	1	16	...	4	1	8	...	1	1	8	...	24	4	61

COMPARATIVE Table of Statistics of Accidents in and about the Mines of Tasmania from 1st July, 1892, to 31st December, 1907.

Period.	Number of Miners employed.	Number of Accidents.	Number of Persons.		Total killed and injured.	Average per 1000 killed and injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
1 July, 1892, to 30 June, 1893	3295	28	4	25	29	8·8001	1·214	7·586
,, 1893 ,, 1894	3403	25	7	20	27	7·934	2·057	5·877
,, 1894 ,, 1895	3789	26	4	24	28	7·390	1·058	6·332
,, 1895 ,, 1896	4160	22	7	16	23	5·529	1·682	3·847
,, 1896 ,, 1897	4303	36	7	31	38	8·831	1·627	7·204
,, 1897 ,, 1898	5530	36	13	33	46	8·318	2·351	5·967
,, 1898 ,, 1899	6180	35	9	34	43	6·957	1·456	5·501
,, 1899 ,, 1900	6834	19	7	16	23	3·365	1·024	2·341
,, 1900 ,, 1901	7017	29	8	23	31	4·417	1·140	3·278
,, 1901 ,, 1902	6438	38	7	35	42	6·524	1·088	5·437
,, 1902 ,, 1903	6484	44	6	43	49	7·557	0·925	6·632
,, 1903, to 31 Dec., 1903	5604	27	8	20	28	4·977	1·428	3·569
1 Jan., 1904 ,, 1904	6192	73	9	65	74	11·951	1·454	10·497
,, 1905 ,, 1905	6586	34	7	30	37	5·618	1·063	4·555
,, 1906 ,, 1906	7004	65	4	61	65	9·280	0·571	8·709
,, 1907 ,, 1907	7516	67	6	64	70	9·314	0·798	8·515

REPORTS OF INSPECTORS OF MINES.

MR. INSPECTOR GRIFFIN (stationed at Launceston) reports:—

I have the honour to submit my annual report on mines inspected by me in the Northern and Southern, North-Eastern and Eastern Divisions of the State for the year ending 31st December, 1907.

Accidents.—Three fatal and 21 non-fatal accidents have been reported and recorded during the year. A detailed list is appended to this report.

The number of fatal accidents, three, is the same as for the preceding year. The non-fatal is much lower than for the preceding year, being 21, as against 28 in the year 1906. One of the fatal accidents, the man Edward Bradshaw, who was killed when working alone in his miner's claim, was of a nature that can scarcely be reached, and certainly not controlled by mining rules or inspection. A number of men of this class work about the tin mines, generally by themselves, and very often in old open-cut workings where there is even more danger than in opening up new ground. If seen and spoken to about any apparent defects in the method of working, they feel offended; as to rules and regulations, they know nothing about such things. "There is no one else to be hurt," they say, "and if I cannot look after myself after all the years I have been at the game, well, then it is no use trying to make me by printed rules." I have come to the conclusion that since there is no rule to prevent a man from working by himself, such as care to do so must only take their chance, as a dozen Inspectors could not make them alter their methods. Of the other two fatal accidents, Vaughan was killed in a shaft, and there is certainly no person to blame for the unfortunate occurrence; not so, however, in the derrick accident at the Purdue Mine, where the unfortunate man, Stewart, was the victim of the carelessness of others.

Of the 24 accidents recorded, 15 were surface and nine underground. Thirteen were caused through inexperience or want of caution on the part of the injured men themselves; eight were purely accidental or unavoidable; and the remaining three were due to owners or their managers.

Prosecutions.—In one case only was it found necessary to prosecute for a breach of the regulations. The mine manager of the Moorina Tin Mine was proceeded against under Rule 57 (Part I., First Schedule) for allowing Thomas Brent to work by himself in ground that was dangerous in the open-cut face of the mine. He pleaded guilty, and was fined £2, with 8s. court costs.

Observance of Rules and Regulations.—There is an improvement in this direction. The new "Mining Act" is, I think, being better understood, at least there is not so much opposition to its provisions as at first.

Alteration of a Rule.—The Tasmania Gold Mining Company applied through the Chief Inspector of Mines for an alteration

in General Rule 26 (Part I., First Schedule), to enable it to carry on other work from a shaft in its mine at the same time as the work of shaft-sinking was being proceeded with. The rule referred to forbids the sinking of a shaft "below any place where men are at work, unless such shaft, to a width of the winding compartments below such place, be covered by a securely-constructed pent-house." The winding engine is at the surface, and sinking operations were going on at or below the 1250-feet level. The shaft is a large one, five times as great in sectional area as ordinary mining shafts, and sinking from the 1000-feet level by means of buckets and air-winch would be too slow. The company commenced cross-cutting from the 1250-feet level, but no mullock or material was caged from this place, excepting at such times as the men engaged shaft-sinking were out of the bottom. This was safe enough, but according to the wording of Rule 26 could not be permitted. I had therefore to order its discontinuance, and recommended the company to apply for an alteration, which the Governor in Council, under Section 197 of "The Mining Act, 1905," is empowered to make, if recommended by the Chief Inspector of Mines, in connection with the working of any mine where the observance of the general rules is not reasonably practicable. The application was granted, and the rule altered to read:—"During shaft-sinking operations no material or tools shall be caged from any other place in such shaft while men are at work in the bottom of the shaft, unless the winding compartment so used be protected to its full width below such place by a securely-constructed pent-house." The object of the rule in the first place was that men shaft-sinking should be protected from injury by things falling down the shaft, such as stone, mullock, tools, drills, &c., when being hoisted or lowered by, put on, or taken off any cage or bucket working in the shaft. The alteration now permits this company to sink with cages, and to do other work, such as cross-cutting, driving, rising, &c., at the same time, and without pent-house protection, provided that no material or tools from such working places shall be caged, hoisted, or lowered, excepting at such times as all men are out of the shaft.

Complaints.—No complaints in writing, that is complaints strictly within the meaning of Section 178 of the Act, were received during the year. Complaints from anonymous writers have been received, but of these, of course, the Inspector is not required to take any notice; nevertheless, they are considered, and sometimes found on subsequent investigation to be not altogether without foundation. One complaint, however, made in writing was not anonymous, but the writer was not "a person employed in the mine" he referred to. This had reference to the, as it was alleged, unsafe condition of a long tail-race tunnel (900 feet long) on the Weldborough Tin Mining Company's mine, which it was said was a death-trap into which men were afraid to go, preferring to leave the mine rather than risk their lives in such a place. I had frequently inspected the tunnel, and had not much doubt as to its being safe enough. Now, however, that a complaint had been made, I made a special journey to the mine, about 80 miles by rail and coach, to find when I got there that there was little or no truth in the complaint made. As to men having left the mine because it was

considered dangerous, this was a pure fabrication. Subsequent to my inspection the mine manager wrote complaining that the timbering of the covered race, referred to above, had been tampered with, that two or three sets were knocked down, and that he evidently had an enemy in the neighbourhood. Under our new Act the Inspector is not allowed to divulge the name of his informant in cases where a complaint is made as to the insecure state or alleged danger in a mine, no matter whether such complaint is found to be frivolous or not. This may be well enough so far as it applies to miners actually engaged in the mine, but not so when applied to outsiders, such as my informant in this case. In such cases the name of the informant should be disclosed, and thus give the person complained against an opportunity of defending himself.

Explosives.—No casualties have occurred during the year from the use or handling of high explosives, which is mainly due to more care being taken in storing, handling, charging, &c. Magazines as a rule are kept in good order, dry, and well ventilated.

Equipment.—There is an improvement in the general equipment of mines worked from shafts, and it was not found necessary to condemn any rope, chain, hook, or safety appliance in use. It is, in these times, rarely that accidents occur from the breaking of ropes or chains. Careful inspection, cleaning, changing, and recapping, such as is now the practice in all, or nearly all, the big mines, is better than trusting to even the best safety appliances.

Ventilation.—The metalliferous mines have fairly good, in some cases very good, ventilation, supplied by natural means, excepting in one or two cases where small blower-fans are in use. The Tasmania Gold Mine at Beaconsfield, from being one of the worst ventilated mines in the State a few years ago, has now good ventilation, obtained solely by natural means. Natural ventilation is, however, subject to atmospheric changes. When the temperature at the surface is higher than in the mine, circulation fluctuates or ceases altogether; and mechanical appliances are then required. At this mine two of the large working shafts (Hart's and Grubb's), as also the Lefroy air-shaft close to these, are down-cast, the cold air passing to the deepest parts of the mine, thence circulating upwards through the workings and westward, until it finds a return to the surface by means of the up-cast shafts, four in number, viz., Florence, Phoenix, Gate, and old main shaft—the latter is sometimes used as down-cast. The rise in temperature in the pyritic and limestone belts out west at the old upper levels materially aid the pull on the air current. There are of course places in the mine, such as winzes, dead ends, &c., that natural ventilation unaided by mechanical appliances scarcely reaches. The North Tasmania Gold Mine, now owned by the Tasmania Gold Mining Company, Limited, who purchased this property during the year, has been undergoing a thorough overhaul. A large Root-blower, formerly used in the big mine, is being installed, and in all probability will effect good ventilation in this gas-hole of a mine, where even moderately good air was unknown before. The deep mines at Mathinna—New Golden Gate and Tasmanian Consols—the working shafts of which are

only about 100 yards apart, are now connected by drives at the 1500-feet levels; by this means improved ventilation is secured to both mines. The "Consols" mine was, until this connection was made, dependent on a single shaft for all purposes, and although the ventilation of the mine was not to say bad, at any time, yet there was always a sense of insecurity where there was only one means of escape for the men from a deep (1600 feet) mine like this. Under First Schedule, Part I., General Rules, Section 1, of "The Mining Act, 1905," the Inspector is empowered, subject to the authority of the Minister, to order the construction of connecting drives for ventilation and escape at the joint expense of the owners, provided the workings are not more than 300 feet apart. The connection made in these mines was simple enough, as on both sides drives had already been constructed up to the boundary. There was at first some dissent on the part of the "Gate" company, who objected to an entrance being made to their mine over which they would not have complete control. Questions were also asked, "In the event of one mine being abandoned, and water rising to the connecting level and flowing into the other mine still working, what indemnity would the latter mine have against costs incurred in preventing this?" Water would never rise to the air-connecting level in the Consols so long as the workings in the "Gate" mine, only a short distance away, were below that level. The "Gate" shaft is now 200 feet below the bottom of the "Consols" mine, and 300 feet below the connecting drive between the two mines. The foregoing objections were, however, overcome by explanations given, and the two mines were connected at the joint cost of the companies concerned, without the Inspector having to resort to compulsory measures. Both mines have now fairly good ventilation. The other metalliferous mines have, as a rule, fairly good ventilation.

Coal Mines.—The smaller collieries are for the most part well ventilated by natural means. Of the larger ones, the Mt. Nicholas and Cornwall have each returns to up-cast furnace shafts. The Sandfly, which has recently suspended operations, for a time at least, depended entirely on natural ventilation; latterly, however, the ventilation has not been good in places, and either fan or furnace will be required when work in this mine is again resumed.

The Mt. Nicholas Colliery has had passable ventilation during the year, rather erratic at times, owing to the scattered workings in the old pit and leakages into the return air-way, where they should not occur if a little more care were taken.

Cornwall Colliery.—There is not much improvement in the ventilation of this mine, as compared with what it was a year ago, when I refrained only from condemning it as inadequate on the understanding that the company would procure and instal an electric fan to improve the ventilation. The fan has not yet reached the mine, but, I am informed, will soon come to hand; it had to be ordered from America, hence the delay. In April last the system of working was altered from "pillar and bord" to "long-wall"; since then the ventilation has improved somewhat, as the circulation of air is made easier by reason of the continuity of the long-wall face as compared with the other method of working, where the air has to be portioned off into each bord. The electric haulage also helps to improve ventila-

›n, as apart from the breathing of horses and the amount of ygen used up, there is dust constantly from their feet that okes the air-ways.

Accidents or Mishaps not attended with Injury to any Per-n.—The following were not reported directly. In some cases cidents or mishaps of this kind are recorded in the weekly spection book at the mine; others, again, are neither reported ›r recorded:—

The eastern cage at main shaft, Tasmania Gold Mine, was pop-t-headed. The detaching-hook acted all right, and no damage ıs done. This was not a case of over-crowding, but the engine-iver, Thos. Owen, started the engine the wrong way, the cage ing from the brace instead of being lowered. Owen, whose st record as an engine-driver is good, he having worked on this ne for the past 29 years as driver without having a mishap, ıs allowed to remain on—an exception to the rule.

At the Cornwall Colliery one of the ponies in use in the mine uling the skips from the faces to the terminus of the electric ım-line was electrocuted by coming in contact with the copper ble that runs along beneath the roof of the main heading. ıe animal, in turning round touched with its ears the wire. slight shock caused it to plunge and catch the iron hames on e wire, and it is thought the animal's shod foot must have uched the iron tram-rail at the same time, as it was instantly lled. Provision has since been made for switching off the cur-nt while the ponies and drivers are at the terminus. I have so given orders that the electric current is to be cut off at the ›wer-house during such time as men are passing to and from eir work, morning and evening. No serious results have so r arisen from contact with the wire, although several men, cluding the manager, and even the Inspector, have had slight ocks, often through the medium of a wet hat. It would seem at the risk of fatal, or even serious, accident is not great unless ıe's foot is on the rail at the same time as head or hand comes contact with the wire above.

Inspection.—The mines in the different divisions allotted to › have been visited and inspected as often as practicable. the incipal ones four times in the year, less important ones three nes; outlying places, such as Middlesex in the west, and the al mines of the south, were visited twice during the year. ıecial visits were made to Gladstone (twice), Beaconsfield. ırnie Copper Mine, Sandfly Colliery, Moorina, Derby, and eldborough (once each). The cause of all serious accidents, well as the fatal ones, was enquired into as soon as practicable. .d in most cases an inspection of the place before it was inter-red with was made, excepting in some cases of non-fatal acci-nts, where inspection before work is resumed is not necessary. ıd the enquiry can be made on the occasion of my next visit the locality. I find that inspection of the place, and a orough investigation into the cause of accidents of a serious ıture, where there is implied negligence on the part of anager or man, has a salutary effect, especially if made without ıdue delay, and witnesses are examined on oath. Some men. ıd indeed some managers as well, do not appear to realise that ıey themselves have erred, or have even been guilty of a breach the Mining Regulations, until in giving evidence at an enquiry

they have to admit a want of knowledge of the provisions of the Act, or even negligence.

Progress of Mines.—In gold-mining no new mines of any consequence have been added to the list. An attempt was made to reopen some of the old mines on the Lyndhurst Field. Mr. John Wren, of Melbourne, expended a good sum in having the Prince Imperial and other reefs there tested, but the whole venture suddenly collapsed. The Lyndhurst G.M. Company is doing something at the old Southern Cross Mine, but so far progress is slow.

Lefroy.—There is not much doing on this field. Mr. G. Barker made a discovery at Back Creek; an iron formation carrying gold at its junction with a small quartz reef. Some sinking is being done, but so far the iron has not been proved to be the capping of a payable reef. Clark, Hill, and party discovered a small reef near the Point and Crown, on which they have sunk a small windlass shaft 50 feet, and opened on from 12 to 15 inches of stone. A trial crushing of 6 tons from near the surface gave 7 ounces of gold. This show is called the "Blue Jacket." New Pinafore has done a lot of prospecting for both lode and shallow alluvial during the past year, but has not succeeded in discovering anything worth mentioning. The company is now turning its attention to prospecting the deep lead, with a view to working this alluvial. The inception of the lead is on the Lefroy township. Government aid will be given, to assist the company in this work. Thousands of pounds have been expended in prospecting for reefs in the Lefroy district, but very little has been done to prove the value of the deep lead known to exist there, and there are good and substantial reasons for believing it to be rich in alluvial gold.

Beaconsfield.—The Bonanza Company has sunk its shaft 200 feet; the total depth is now 800 feet. A steam-winding plant was installed at the beginning of the year. This has greatly facilitated sinking operations. Tasmania Gold Mine.—Grubb's shaft has been sunk a further depth of 300 feet below the 1000-feet level. A plat was cut at 1250 feet, and a crosscut is now being driven at this level. Hart's shaft was sunk another 100 feet or so below the 1100-feet level, but operations had to be suspended for the time being on account of the great in-flow of water. The main drainage is intercepted here before reaching Grubb's shaft, which is further to the east. The old main shaft pump has been dismantled, and columns drawn, as there is no further use for it at this place, the water being now pumped from the deeper levels by the three pumps, two of which are at Grubb's and one at Hart's shaft. These new pumps are working smoothly and well, and were, in November, throwing four and a half million gallons per day. North Tasmania Gold Mine.—This property is now owned by the Tasmania Company, which has cleaned up and repaired the levels and stopes, overhauled the machinery, installed a powerful ventilating fan, and otherwise put things in order preparatory to the commencement of extensive prospecting operations. The East Tasmania had the diamond-drill at work, and bored to a depth of a thousand feet or so, but has long since ceased work. Mr. W. J. Phillipson (Tasmania Tailings Syndicate) is still working away at the sand, and obtaining values up to 2 dwts. by cyaniding. A new boiler has been added to the barge plant on the creek.

Mathinna.—New Golden Gate Company has sunk its main shaft 200 feet on to the 1800-feet level, at which depth the reefs, both east and west of the shaft, have been cut. Tasmania Consols.—Battery concentrating works reconstructed and added to, boilers grouped, incline haulage-line constructed from shaft to battery, and stone-crusher added to plant. These improvements have reduced cost of crushing and concentrating, &c., by 50 per cent., as compared with the old plant. A "Schram-Hasker" diamond-drill purchased by the company is in use in the mine, boring horizontally at the bottom levels. The Miner's Dream has not done much, but is still alive. The City of Hobart Company had a reef on its property tested by B. Searl and party working on tribute, but it did not last long. The Volunteer group is still idle.

Alberton.—The New Ringarooma Gold Syndicate has been working, with varying success; want of capital is the trouble. New River Freehold G.M. Company has obtained more capital, and was about to resume work at the close of the year.

At Golconda the New Wyengatta Gold Mining Company resumed work in August. New poppet-heads have been erected, and a steam-winding plant installed. The company is now in a better way of working than heretofore, and the prospects in the mine are very encouraging. The New Panama G.M. Company is tunnelling and prospecting, but nothing has been discovered to warrant opening up on.

Tin Mines.—North-Eastern Division.—The New Aberfoyle T.M. Company constructed a head-race 21 miles from the off-take on the Boobyalla River to their tin mine on the Ringarooma River, which is now being opened up. The source of water-supply is not very good in the summer time. The complete failure of the Cybele Tin Mining Company came as a surprise only to those who were unacquainted with the locality and circumstances. The Purdue Tin Mines Company commenced the erection of a pumping plant early in the year. This was completed some three months ago, since which time sluicing operations have been carried on with very satisfactory results. The plant comprises a three-stage 12-inch centrifugal pump, 15-inch rising main, Allen engine, Babcock boilers capable of throwing 11¼ sluice-heads (1725 gals. per minute) to a height of 172 feet. The water is brought into the pump-sump, which is 30 feet above the river, by means of a large head-race, 4 miles in length, with its off-take on the Ringarooma River. By this means risk of stoppages during times of flood are being avoided; it also offers a means of getting rid of a lot of sand. The South Mount Cameron Tin Company has replaced its old pump by a more powerful and up-to-date one. The Pioneer Extended Company has purchased the plant (gravel pump, engine, boiler, &c.) of the Weldbrook Tin Mining Company. The Pioneer Tin Mining Company has, during the year, added a fourth barge and pumping plant to their works. An extraordinary rainfall occurred in February last, and the mine was flooded through the sudden overflow of Bradshaw's Creek. The three plants at work were completely submerged, and it was nearly three months before sluicing operations could be again resumed. Fortunately the new plant, although nearly finished, was not in position for working, and could be kept afloat; it was soon finished, and used for pumping out the flood-water. The company is now

about to commence the construction of a large reservoir on the Frome River, for the purpose of running an electric power station, which will be capable of supplying electric energy sufficient to drive all the machinery on the mine. The Briseis Tin Mines Company commenced sluicing off the overburden at the North Briseis (late Ringarooma Company). A large main has been laid across the Ringarooma to carry a supply of water from the company's upper race. A series of prospecting tunnels have been put in from a little above river-level on the western side of the hill, to test the drift. The Arba Tin Mine is now well equipped with machinery, and good progress is being made. The T.P.C. Mine is still going on the lode formation. The percentage of tin is low, and there is a good deal of copper, which does not help matters. An option syndicate has been prospecting the old Bell's Hill lode, but nothing much has come of this.

Weldborough.—The Weldbrook Tin Company has ceased to exist. The plant was purchased by the Pioneer Extended Company. The Fancy Creek Company have had some very heavy slips of the basaltic overburden in their open-cut face on the township section. There is no wash or drift at this face. The basaltic covering is on a soft granite intersected with innumerable small quartz veins, from mere threads up to 4 or 5 inches in thickness; these carry tin, which is won by sluicing away the soft granite. The Weldborough Tin Company has a few men working on a formation similar to the Fancy Creek, of which mine it is a close neighbour. The Mutual Hill Tin Mine Company finished its head-race construction, pipe-laying, &c., some few months back, since which time the work of opening up the mine has been carried on. So far the overburden of basalt, chiefly soil and loose boulders, has been brought down and sluiced off or removed from the tin-drift level. This is a great mistake, when the fall into Main Creek on the west side offers such splendid facilities for getting rid of the overburden, the Ringarooma fall on the north side being the outlet for the tin-drift sluices. If properly managed, this mine will, I believe, come to the front as a tin-producer. Briseis Extended Company.—Latterly good progress has been made in the way of removing the top stuff, comprised of modern river shingle and surface sand. In doing this some few feet depth of the older bottom drift was sluiced off and some very nice seams of tin exposed. Mount Paris Tin Company has been getting some ore from the old tunnels. A new tunnel is now being driven to test the lode-formation higher up the hill. It is understood that the company is about to enter upon a more comprehensive scheme of working, and that the battery and concentrating machinery will be removed to a lower site near the Dorset River, where water can be obtained and used, to take the place of the steam power now in use. Anchor Tin Mine.—Mr. J. B. Lewis has done everything posible to be done in the way of reducing working costs. The fall in the price of tin has, however, caused considerable speculation as to what will be the fate of this, as well as other mines, working on low-grade ores should the tin market go much lower.

St. Helens.—Not much doing round here. The Royal Ruby and Thureau's Deep Lead companies are working, but on a very limited scale. The Priory tin lode was worked for a time, and one or two crushings were made with a five-head battery

erected at the mine. The lode was not payable, and the plant was sold to the Full Moon Company at the Blue Tier.

Avoca District.—The Mt. Rex Company did some driving south at the No. 1 level in their mine, but nothing came of this. They are now driving at the bottom level, on the course of a horizontal diamond-drill bore, to tap some stone discovered by the drill. The machinery has been idle during the year. Some alluvial is being worked, with fairly good results. The Gipp's Creek alluvial mine is working, but the output is not large. Twenty men, single or in small parties, are working at head of Story Creek, getting tin and wolfram. The Story Creek Alluvial Company worked for a few months, and closed down. Brookstead Estate Option Syndicate.—During the year an option has been held by Messrs. Hancock and other South Australian gentlemen over this estate, which is the property of Messrs. Fitzgerald, and is situate on the St. Paul's River, 12 miles by road from the Avoca township. Six to seven thousand pounds have been expended in prospecting the very extensive alluvial deposits, as well as the tin lodes known to exist, and with, it is understood, satisfactory results. Before finally deciding to take over the property, however, the syndicate approached the Government *re* the tailings question. Pollution of the South Esk River, into which the St. Paul's flows, has been going on for several years past, owing to sludge tailings, and even gravel, being allowed to pass into it from the sluicing operations of several tin mines in the vicinity of Avoca and South Ben Lomond. Complaints have been made by landholders, farmers, and graziers having frontages on or through whose property the Esk flows, many of whom use the water for domestic purposes, of the discolouration and the amount of silt it contains. The township supplies of Evandale and Perth are affected, and the authorities of these places complain of the quantity of silt deposited in tanks and reservoirs. It is felt that something must be done, and done without unnecessary delay, to prevent further pollution of this river, which has a course from Avoca to Launceston, of 70 or 80 miles, through a very fine pastoral and agricultural country. It is claimed by those directly interested in alluvial tin mining that this branch of the industry cannot be carried on profitably unless those engaged in it are allowed to deposit tailings, &c., in the stream flowing through the mining areas. To settle, as far as possible, the question, so far as the Brookstead Option Syndicate and the depositing of tailings in the St. Paul's would be concerned, the Government desired information, and instructed Mr. W. H. Twelvetrees, Government Geologist, and myself to report "as to whether the alluvial tin deposits there can be worked without putting tailings into the St. Paul's River." We are of opinion that they can, *vide* our report furnished to the Secretary for Mines under date 6th November, 1907.

Silver Mines.—The Round Hill Silver Mine Company at Mt. Claude, near Sheffield, commenced operations about the half-year in the old Mt. Claude tunnels. Subsequently an entirely new discovery was made further west. A large body of ore was uncovered, which is said to give highly satisfactory results of both silver and lead. The Devon Silver Mine on the Dove River, Middlesex, has been working, and showing improved values during the year. Operations are a good deal hampered

owing to the difficulty of getting supplies into, and ore away from, this almost inaccessible locality. Everything has to be packed in the winter time to the Shepherd and Murphy Mine, 8 miles, and in summer time to the top of the Caledonian Hill (5 miles rise), a rise of about 1600 feet in 3 miles of winding and zig-zag pack-track. There are times during the winter when communication with the outside is completely cut off by floods, snow storms, &c. Shepherd and Murphy Mine (tin, bismuth, and wolfram).—The company completed a new head-race, which has greatly added to the water-supply, and has given increased head-pressure for driving the battery and machinery. A thorough overhaul of the machinery was made, additions and improvements effected, and the plant made more efficient in every way. Latterly mining operations have been going on steadily. Burnie Copper Mine.—A lot has been done during the year in the way of surface work and mine development. A main shaft 14 feet by 4 feet 6 inches was put down 150 feet, and equipped with steam-winding plant, safety cages, &c. This is only a temporary plant, to be replaced by more powerful machinery if the mine proves payable. A lot of surface work had to be done, such as cleaning, road-making, building, &c. Quite a township has sprung up on the hill where the mine road junctions with the road leading up from Hythe to the "West Pine." The name of the new township is "Cuprona." Copper Creek Syndicate Mine.—Situate on the Leven River, west of Gunn's Plains, about 12 miles from Ulverstone. This is as yet only in the prospecting stage. Some tunnelling has been done, and the main lode cut at a shallow level. An adit is now being driven from the creek level.

Coal Mines.—There is not much that is new in the way of development in connection with these. The Nicholas Company opened a new pit on the 4-feet seam west of the old workings. Frequent faulting of the seam in these latter made long-wall most difficult working, and further extension in a north-easterly direction had to be abandoned. Some few places are still going, working back to the south-east and towards the outcrop. Work has also been resumed on the 6-feet seam, which is 15 to 20 feet above the "4-feet." Only 4 feet of the bottom coal is being sent to market. The remaining 2 feet of top coal is difficult to clean, on account of several thin bands running through it. Prospecting, for what there is good reason to believe will eventuate in the discovery of a large seam, is now going on. Bores put down some 75 feet from the level of, and not far from the entrance to, the present working tunnel, have in each case bottomed in a cavity 11 feet deep, supposed to be formed by the burning out of a large coal seam. The fact of there being no sign of a seam outcropping on the hillside at this level is in favour of the "burned out" theory, as in the event of the seam being burned out at the outcrop subsequent subsidence of the surface soil and rock would obliterate any trace of the outcrop. The Cornwall Colliery has changed from the "pillar and bord" to the "long-wall" system of working, and the change is proving to be of great advantage in the working of the mine. The Sandfly Colliery Company has suspended mining operations, owing to financial difficulties. The great cost involved in the construction of 12¼ miles tramway from the mine to North-West Bay, together with jetty-building, rolling-stock, &c., proved to

be too great a burden in addition to the excessive cost of mining and getting the coal to market. The tramway, with its quick curves and steep gradients, is a costly line to work and maintain, and this, added to the cost at the mine, which appears to have been excessive, brought things to a climax. Nothing has been done at the Catamaran Coal Mine during the year. It seems a pity that this coal seam, which for size and quality of coal is certainly the best in the southern part of the State, should be neglected.

Bucket-dredging.—The Gladstone dredge has been doing fairly well during the year. At South Mt. Cameron the Dorset Company's new dredge was started about the half-year, and is working with satisfactory results. This is one of the largest, best-equipped, and most powerful bucket-dredges in use for mineral working in the Commonwealth States or New Zealand. The cost of working this, as compared with either of the other (Gladstone or Ringarooma) dredges is not much greater; the result in tin won is more than the two put together.

LIST of Accidents in Inspector Griffin's District for Year 1907.

Fatal, 3 ; non-fatal, 21 ; total, 24.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1907.							
23 Jan.	Sandfly Colliery Co.	Margate	Explosion of powder	Roberts, Milford	Married	Scorched hand and side of body	Was stooping to take two plugs (about ¾ lb.) of powder out of a tin when it exploded ; he sustained burns on hand and side of body
9 Feb.	Briseis Tin Mines Ltd.	Derby	Fall of earth from open-cut face	Sullivan, Sydney	Single	Cuts on head and bruised back	Working in open-cut face: heavy fall from face carried out further than usual ; Sullivan fell when running away and was caught by stuff from fall
19 Feb.	Moorina Tin Mine	Moorina	Fall of earth in open-cut face	Brent, Thomas	Ditto	Left leg broken below knee	Employed as nozzleman. he was working by himself during night time, when a heavy fall came away from the face and caught him as he attempted to escape
24 Feb.	Tasmania Gold Mining Co. Ltd.	Beaconsfield	Sudden escape of steam when uncovering cylinder	Burt, Wm.	Ditto	Scalded on both arms	Was assisting to take off cover of h.p. cylinder of pump engine ; some steam left in cylinder through drum cock being stopped, caused it to spring off suddenly, and Burt was scalded
7 Mar.	Ditto	Ditto	Caught his arm round cap-piece to save falling & strained muscles	O'Toole, W.	Ditto	Muscles of arm strained	Was working in stope, and stooping over, when a small piece of wood struck him on the head ; to save falling he caught hold of the cap piece and strained the muscles of his arm

			der			body and cuts on arm	shaft; slipped when just at top of ladder, and fell 19 feet to bottom, sustaining broken thigh, also cuts on arm
8 April	Ditto	Ditto	Attempting to get off a cage while it was moving	Floyed, Thos.	Ditto	Sprained back	Attempted to get off top deck of cage before it was lowered on to catches; cage ascended again, and he was caught under some staging and got a squeeze
3 May	Mt. Nicholas Colliery	Mount Nicholas	Slipped on tramline	Rigby, Wm.	Single	Top joint of thumb jammed off	Was pushing a skip on tram-line, slipped and fell; wheel of skip passed over his thumb, crushing top joint off
About 10 April	Miner's Claim, Britannia Creek	Upper Cascade, Ringarooma	Fall of earth in open-cut face	Bradshaw, Edward	Ditto	Fatal	Was tin mining in old open-cut workings and worked alone; being missed for several days a search was made, when Bradshaw's body was found buried up in debris
9 May	Bonanza G.M. Co.	Beaconsfield	Lowering cage, got foot caught	Hampton, John	Married	Jammed foot	Was assisting to lower a cage from vertical to horizontal position; got his foot jammed beneath it as it fell
13 May	Tasmania Gold Mining Co.	Ditto	Caught in machinery in motion	Cutterill, George	Single	Two fingers jammed	Cleaning stuffing box of cylinder, got his fingers jammed between guard-plate and slide-block
22 May	Purdue Tin Mining Co.	Gladstone	Breaking of guy-rope	Stewart, George	Married	Fatal	Was engaged bricklaying beneath Babcock boiler; a strain was being put on tackle to lift steel smoke-stack, guy rope snapped, shear legs fell, plank struck Stewart on head

LIST of Accidents in Inspector Griffin's District for Year 1907—continued.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1907.							
10 June	Tasmania Gold Mining Co.	Beaconsfield	Door of tool-box slamming	Lee, John	Married	Fingers jammed	Was employed at Beauty Point jetty works; was putting tools in large box, when the door suddenly slammed and jammed his fingers
5 July	Moorina Tin Mine Co.	Moorina	Fall of earth in open-cut face	Amos, Leslie	Ditto	Fracture of left thighbone	Was on night shift attending to nozzle in open-cut workings; went rather near to the face and was struck by a large lump from a heavy fall that took place
10 July	New Aberfoyle Tin Mining Co.	On Waterrace 12 miles west, Gladstone	Fall of earth in shallow pit or shaft	Vaughan, Albert Austin	Ditto	Fracture of skull. Fatal	Was timbering up trial pit, 12 feet deep, in line of waterrace tunnel; a large lump of stuff fell on him from side shaft, a lath fracturing his skull
6 July	Thureau's Deep-lead Tin Mine Co.	St Helens	Fall of earth in open-cut face	Morling, Wm.	Ditto	Broken arm	Worked by himself as tributor; went too near face and was caught by a fall of earth
20 July	Tasmania Gold Mining Co.	Beaconsfield	Caught in machinery in motion	Smith, Harold	Single	Right arm torn off at shoulder	Engaged as vanner boy; attempted to snatch off belting that had become wound around a pulley in motion; got his hand caught, and his arm was torn off
27 July	Ditto	Ditto	Small piece of stone	Goodson, John	Married	Severe cut on wrist	Engaged at sinking of "Grubb" shaft; a small piece of stone

							striking him across the back.
28 Sept.	Ditto	Ditto	Fingers caught between skip and prop	Hudson, George	Ditto	Fingers badly jammed, first joint of two amputated	Hudson was working in coal face and tried to run out a loaded skip, the wheeler not being there, and got two fingers jammed; top joints had to be amputated
17 Oct.	Anchor Tin Mine Ltd.	Lottah	Fell before empty truck	Burr, Wm.	Single	Bruised about hips and buttocks	Horse-driving on tramway, slipped and fell before empty waggon, wheels passed over his body; he was apparently not much injured, but was a week in hospital
14 Nov.	Tasmanian Consols G.M.	Mathinna	Foot caught by crank of engine	Street, Edward	Married	First joint of great toe cut off	Street left his work as lander, and went to talk to engine-driver; he inadvertently put his foot on bed log of engine and had his great toe cut off
17 Aug.	Anchor Tin Mine Ltd.	Lottah	Bar slipping, fall on rock	Lehner, J. W.	Ditto	Severe cut on head	Lehner was barring down stone in open-cut face: a flake of stone broke, and he fell, sustaining bad cut on head.
6 Dec.	Tasmania G.M. Co.	Beaconsfield	Mullock falling from hanging-wall	Kerrison, Walter	Ditto	Two fingers badly crushed	Was cleaning down in stope when a large piece of mullock fell from hanging-wall, crushing his fingers

MR. INSPECTOR HARRISON (stationed at Zeehan) reports:—

In submitting my annual report, I am pleased to state that the field generally is in a very prosperous condition.

Safety Appliances, Ropes, and Cages.—All the mines worked by machinery are well supplied with the necessary safety appliances. Ropes are examined, tested, and condemned if considered necessary. Cages are tested by both managers and Inspector as often as convenient.

Ventilation.—The ventilation of the mines is good, and there have been no complaints in this respect.

Magazines.—These are kept clean and in good order. Most of those constructed for the mines are underground. This system, I consider, to be the safest and best.

Health of Employees.—The health of the miners on the whole is good. The principle disease the doctors have to contend with is pneumonia, brought about by excessive rains and very changeable weather.

Accidents.—I regret to state we had two fatal accidents and 21 others. Seven of the latter were from the Tasmanian Smelting Company, and should not be classed as mining accidents. One of the former was of an avoidable character.

Prospects of the Field.—The Zeehan portion of the district is well maintaining its reputation as a producer of high-class galena ore. The Mount Zeehan (Tasmania) Company is putting down another main shaft, on which powerful machinery has been erected. While the deeper levels of the Spray workings of this extensive property fully prove by their value the necessity of a main shaft. Zeehan-Montana.—This mine is worked from three main shafts, all of which are raising payable ore. Zeehan-Western.—The mine is worked principally by tributers, but the manager is now making arrangements to sink his main shaft to a depth of 1000 feet. Oonah.—Arrangements are being made for the erection of smelters on the field, to treat the large bodies of stannite ore that have been exposed in the deeper levels. The mine also gives employment to tributers, who are working the shallow levels to advantage. From the western lodes large quantities of sulphide ore of low grade are being sent to Melbourne for the manufacture of manures. Florence.—This mine is turning out rich ore in considerable quantities, and is giving good returns to both the proprietors and the tributers. Comet Bell.—Has completed sinking its main shaft, and is now cross-cutting to strike the lode. Silver King.—Property still idle, with the exception of a very few tributers working on the surface. Colonel North.—Getting ready to unwater main shaft. Victoria-Zeehan.—Erecting good pumping and winding plant on new main shaft.

Dundas.—The Comet Mine has been worked successfully by tributers for several years; but they are not in a position to go any deeper, and I am afraid if assistance is not given by the company, the mine will soon have to close down. There are large lodes of low-grade fluxing ores that can be worked above water-level if a market could be obtained. West Comet.—This mine still continues to supply the local smelters with fluxing ores of good character.

Mt. Read.—The Hercules Company supplies the smelters with the usual amount of sulphide ore, and gives employment to about 100 men. The Mount Read Company has also a few men employed, but their year's work has not proved a success. Ring Valley.—A fair supply of rich fahl ore has been sent away during the year, but the manager finds it necessary to suspend mining operations pending the erection of a plant that will allow him to sink.

Rosebery.—The Tasmanian Copper Company has opened up immense bodies of sulphide ore, and supplies about 1000 tons per month to the Zeehan Smelters. The Primrose Company is also delivering ore of similar character. The Colebrook Company is busy erecting a smelting furnace, constructing trams, and getting ready to turn its ore into matte on an extensive scale.

Mt. Farrell.—The North Mt. Farrell Company still maintains a large output of high-class galena ores. The capacity of the dressing mill has been about doubled during the year. We have also the Mt. Farrell, Thomas' Blocks, the Tullah P.A., and Mt. Farrell Blocks, all working with good prospects. The Murchison River Company has shut down for the time being.

Waratah.—During the year the prospects of the Bischoff Tin Mining Company have very much improved. The same applies to the Bischoff Extended. The Cleveland Mine at the Whyte River is erecting a 10-head battery.

North-East Dundas.—Several very important and extensive finds have been made in this direction. A number of men are working the alluvial deposits, and machinery will soon be employed treating the rich lodes that have been discovered.

Heemskirk.—The northern portion of this field is engaging more attention than it was. A strong syndicate is prospecting the Tasman River flats, with the intention of building a dredge. There are also a numter of small parties working the alluvial on various portions of the mount; some of them with very good results.

Stanley River.—This field is still idle, as there is no proper means of communication from Zeehan. Until a bridge is put over the Pieman River this large district is likely to remain idle.

General.—Prospectors are out in all directions, and we have numerous small parties at work. I am pleased to state that the Government has adopted a good progressive policy in opening up tracks and erecting wire-rope crossings over the rivers, which allow the prospector to go further afield without the chance of being cut off by floods.

LIST of Accidents in Inspector Harrison's District for Year 1907.

Fatal, 2; non-fatal, 21; total, 23.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1907.							
6 Jan.	Tasmanian Smelting Co.'s Works	Zeehan	Slip of timber	Lyng, H. C.	Married	Loss of thumb and crushed index finger	Caused by slip of timber while erecting large shed
2 Jan.	Comet S.L.M Co.	Dundas	Fall with truck	Jeffries, J. J.	—	Sprained ankle and bruises on face and shoulders	In trucking, opened the wrong door of the shaft, and ran the truck into open compartment, falling after it 75 feet into water
4 Jan.	Tasmanian Smelting Co's Works	Zeehan	Tapping furnace	Gleeson, P.	—	Burns on ankle and foot	In tapping, slag stream was so diverted that it ran over his foot
8 Feb.	Mt. Bischoff	Waratah	Struck by stone	Smith, Robt.	Single	Fractured skull	Struck with stone while feeding stone-crusher
24 Feb.	Tasmanian Smelting Co.'s Works	Zeehan	Splash from slag pot	Large, Chas.	Ditto	Burns on foot	While tipping slag pot it struck side of bank
30 Mar.	Magnet	Magnet	Boiler pipe bursting	Hogan, M	Ditto	Burns on face and hands	Blow-pipe of boiler burst and blew boiler door open
	Ditto	Ditto	Ditto	Collins, Henry	Married	Ditto	
	Ditto	Ditto	Ditto	Evans, Robt.	Ditto	Ditto	
2 May	Florence Mine	Zeehan	Fall of earth	Lamerton, Wm.	Ditto	Cut over eye and bruises on body	Working in a trench when a slip took place
8 May	Tasmanian Smelting Co's Works	Ditto	Hand slipped under truck wheel	Brent, Thos.	—	Crushed fingers	Trying to chock wheel of moving slag truck, when hand slipped, and wheel went over fingers
16 May	Mt. Bischoff	Waratah	Caught in belting	Negus, J.	Single	Broken arm and bruises to face,	Was caught in belting while drawing his hand over pulley-

			from cage				his leg
4 July	Tasmanian Smelting Co.'s Works	Ditto	Truck passing over foot	Storey, C.	Married	Crushed foot	Was trucking ore to bins when he caught his foot in staging and the truck went over it
10 July	Hercules	Mount Read	Fall of earth	Bamber, Hy.	Ditto	Fatal	Fall of earth took place in stope crushing his head
8 July	Tasmanian Smelting Co.'s Works	Zeehan	Fall of truck brake	Clifford, Ernest	Single	Crushed foot	Caused by brake of truck falling on his foot
28 July	Hercules	Mount Read	Explosion	Schmidt, Max	Married	Fractured leg, lacerated hand, &c.	Caused by explosion of charge on returning prematurely
28 July	Florence	Zeehan	Escape of hot water	Clough, Wm.	Single	Scalded face, arms, and back	Plug came out of hot-water pipe
30 July	Magnet	Magnet	Fall of rock	Anthony, James	Married	Broken ribs	Fall of rock from hanging-wall
17 Oct.	Mt. Zeehan (Tasmania)	Zeehan	Cage descending	James, John	Single	Fatal	While sinking, the driver allowed cage to descend
2 Sept.	Tasmanian Smelting Co.'s Works	Ditto	Explosion of hot ore	Howson, James	—	Body cut	—
16 Nov.	North Mt. Farrell	Farrell	Fall of stone from blast	Panitzki, Fredk.	Married	Injured shoulder-blade	Stone from open-cut blast fell through roof of shed
11 Dec.	Mt. Bischoff	Waratah	Fell down haulage line	Bartlett, Ernest	Single	Broken collar-bone	Fell 16 feet down inclined haulage line

MR. INSPECTOR CURTAIN (stationed at Queenstown) reports:—

For the statistical year just ended I beg to summarise the various items that have come under my notice.

Accidents.—There were 23 accidents reported, but only one proved fatal. Details are given in the appended list. The tabulated list does not contain accidents of a lesser degree, where the injured persons have not returned to work within the stipulated period, and have not been reported to me.

Mines.—Those in operation were the Mt. Lyell group, Lyell Blocks, Consols, Crown Lyell, Comstock Consolidated, Tasman and Crown Extended, and Copper Mines of the Mt. Lyell West, all of which have put forward efforts to improve their prospects. The chief development is centred in the North Lyell Mine, where, with depth, the ore-body has increased in quantity and quality. Its continuance being recently located at the No. 10 level, which is 1000 feet below the surface outcrop. The average number of men remain similar to that totalled when this part of the State was proclaimed a separate district.

Ropes and Cages.—At present all the working ropes, including those on the main haulage are in good order, which comment may also refer to the cages, these being at stated intervals tested by the mine officials.

Ventilation.—While awaiting connections, exception has had to be taken to the air in close stopes and rises; also the dust arising, especially in the latter, which, as the depth increases and the ground becomes hotter, will need a revision of the regulations, whereby a standard quality of air shall be maintained in all working faces throughout the mine.

Rock-drills.—Where these are used in dry siliceous country, or, for that matter, wherever dust is generated by them, a provision will have to be made in "The Mining Act" definitely stating that in all such cases each machine will have to be provided with an efficient and wholesome spray, or other suitable means of arresting or allaying the dust, otherwise it will be only a matter of time when the evils attending older fields will become established on this one.

Sanitation.—The pan system, in the matter of removing and cleansing, receives attention. There are, however, instances where the smell emanating from these latrines is offensive, and for that reason these "depositories" should receive periodical visits from a qualified health officer.

Explosives.—An accident, accompanied by shock and prostration happened to a ganger while charging a deep hole, by its premature explosion. On examining the ammunition, it was found hard and frozen, which state was subsequently found attending other samples of the same brand underground, necessitating a record being minuted that no nitro-glycerine compound should be issued for immediate use that was not fit and in a suitable state for that purpose. Notice has had to be taken respecting the pernicious practice of permitting loose detonators and plugs of gelignite lying promiscuously about, and thereby providing means for occasioning serious trouble, including the smelters, where a man named O'Connor was injured from that cause. Beyond these instances there is no other that

could be considered as a complaint against the large quantity of explosives that have been used in this district.

Magazines.—Those in use are in good order, especially the three main ones belonging to the Mount Lyell Company, where quantities up to 10 tons are stored in each. This company's annual consumption is about 60 tons.

Gold (Alluvial or Otherwise).—Outside the Mt. Lyell Company's returns there has been a scarcity of this metal, which is likely to continue, as the places which were the chief sources of supply are being abandoned, and as there is little likelihood of younger men taking up this calling, it must eventually cease.

In conclusion I must state that outside the Mt. Lyell Mining and Railway Company, the prospects of the established mines have not improved, but with this company's development at its North Lyell workings the prosperity of the ensuing year is safe.

LIST of Accidents in Inspector Curtain's District for the Year 1907.

Fatal, 1 ; non-fatal, 22 ; total, 23.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1907.							
4 Jan.	Mt. Lyell Mine	Mt. Lyell	Collision of trucks	Jackson, Wm. Rd.	Single	Broken thigh	Empty trucks were run on to the wrong line and collided
25 Jan.	Mt. Lyell Reduction Works	Lyell	Bucket leaving rail	Hurren, James	Ditto	Crushed fingers	His hand got between fastening-clip and front-hanger
16 Jan.	Mt. Lyell M. and R. Co.	North Lyell	Foot slipped	Mears, Alfred Thos.	Married	Broken leg	Slipped while helping to carry a rock-drill
16 Feb.	Ditto	Ditto	Rolling stone	McCulloch, Thos.	Single	Crushed foot	Crushed by a stone which he had dislodged in the stope
21 Mar.	Ditto	Mt. Lyell	Knocked down by trucks	Moore, Robt. Hy.	Married	Bruises on body and leg	Driving horse at the open-cut ; was knocked down by loaded rake
25 April	Mt. Lyell Blocks	North Lyell	Clothes catching belt	McDermott, Gilbert	Single	Cuts on face	Caught while regulating a Wilfley driving-belt
26 April	Mt. Lyell Reduction Works	Queenstown	Fall from platform	Robinson, John	Married	Bruises on head and body	Fell from receiving platform on aerial central station
16 May	Mt. Lyell Blocks	North Lyell	Cut by saw	Schwind, John	Ditto	Cut fingers	Assisting sawyer, when his fingers touched the saw
18 May	Mt. Lyell Reduction Works	Queenstown	Jammed in lift	Timothy, Joseph Jas.	Ditto	Broken foot	While ascending a lift his foot got jammed between lift and side timbers
9 June	Mt. Lyell M. and R. Co.	Mt. Lyell	Moving trucks	Crawford, John	Single	Bruised and shaken	Tried to mount trucks in motion, and was jammed against wall

10 July	Mt. Lyell Blocks	North Lyell	Fall of earth	Hall, Hy.	Ditto	Fatal	Collapse of stope caused instantaneous death
10 July	Ditto	Ditto	Ditto	Simpson, James	Ditto	Scalp wound and shock	Same accident as preceding
16 July	Ditto	Ditto	Timber falling down chute	Thompson, Charles	Ditto	Fractured leg	Timber being shackled, slipped and fell to bottom of chute
28 July	Mt. Lyell M. & R. Co.	Mt. Lyell	Fell over working bench	Major, Geo. Hy.	Ditto	Bruises and sprained ankle	Fell over the bench in open-cut owing to his light going out
July	Ditto	Ditto	Fall of rock	Lake, George	Widower	Shin-bone splintered and bruised	While working at the open-cut a piece of spoil came away
15 Oct.	Mt. Lyell Reduction Works	Queenstown	Fall of m tal-bar	Fordham, Thos.	Single	Crushed foot	Was preparing a bar of metal, when it toppled over
18 Oct.	Mt. Lyell M. & R. Co.	Mt. Lyell	Fall over bench	Lee, Frederick	Married	Bruises and shaking	While landing a machine, fell from one bench to the other
26 Oct.	Ditto	Ditto	Lost his balance and fell	Coates, John	Ditto	Broken leg	Was barring down, when he slipped and fell about 4 feet
28 Oct.	Ditto	Ditto	Fall of stone	Holder, Hy.	Single	Bruised leg	In open-cut a piece of spoil fell and injured his leg
5 Nov.	Ditto	Ditto	Slip of roofing iron	McKenzie, H. R.	Married	Scalp wound and shaking	While reroofing a lean-to an iron-sheet slipped and caused him to fall
18 Nov.	Ditto	Ditto	Slipped while walking	Cox, Robt. Jas.	Single	Broken ankle	Walking down incline; trod on a loose stone, and fell
2 Dec.	Ditto	Ditto	Fall of rock-drill	Nelson, Jno. J.	Married	Abdominal bruises	The drill collared and canted over, falling upon him
23 Dec.	Ditto	Ditto	Ditto	Wilson, John	Single	Scalp wound and cut on arm	A similar accident to the preceding, and the same machine

GEOLOGY OF TASMANIA.

By W. H. TWELVETREES, Government Geologist.

TASMANIA is a geological outlier of Eastern Australia. Its Pre-Cambrian and early Palæozoic history can be delineated only imperfectly. In Mesozoic times some connection existed with the Australian part of Gondwana Land. In the early Tertiary it was separated from the adjacent island continent; subsequently the land connection was restored, to be again broken, since when it has remained an island. Dr. A. W. Howitt and Mr. C. Hedley have pointed out that the last land connection was between Wilson's Promontory in Victoria and Cape Portland in Tasmania, *viâ* Flinders Island and the Kent group, and that an elevation of from 200 to 300 feet would lay dry a tract of country between Victoria and Tasmania.

The rugged nature and the remoteness of the mountain fastnesses of the island have been great impediments to geological research. In spite, however, of the physical difficulties, it has been possible to fix the stratigraphy of a large portion of the State, though the lower Palæozoic strata need further study before they can be satisfactorily determined. As far as examination has proceeded, the following systems can be recognised:—

(1) Pre-Cambrian.
(2) Cambrian.
(3) Ordovician.
(4) Silurian.
(5) Devonian.
(6) Permo-Carboniferous.
(7) Trias and Trias-Jura.
(8) Tertiary.
(9) Quarternary.

(1) *Pre-Cambrian.*—The diagnosis of the Pre-Cambrian must be accepted as provisional. It is probable that they belong to the Algonkian division of the group. Among them may be mentioned the quartzites and mica schists of the Port Davey districts. These are strongly developed in the south-west of the island as biotite and muscovite schists, greatly contorted, alternating with white saccharoidal quartzites, all striking north-west and dipping south-west. High headlands of quartzites, which have resisted denudation, jut out on the south coast, with bare, snow-white crests visible for many miles. Ores of copper, antimony, and lead occur in these schists. The contorted quartz schists and white quartzite of Rocky Cape, on the North-West Coast, are also considered as Pre-Cambrian. These are traversed by granitoid and basic dykes carrying copper ore. The quartzitic and micaceous schists west of the King William and Denison Ranges belong to the Pre-Cambrians. Garnetiferous amphibolite in the Collingwood River Valley, the amphibolite of the Rocky River, enclosing lenses of magnetite and pyrrhotite and copper pyrites, and the zoisite-amphibolite of the Forth River, are also ascribed to the Pre-Cambrian group.

(2) *Cambrian.*—This system is represented by friable yellow sandstones, containing casts of Dikelocephalus, Orthis, Bellerophon, &c. These occur at two widely-separated localities on nearly the same meridian, one being on Caroline Creek, between Railton and Latrobe, the other on the Humboldt Divide in the Florentine Valley. Mr. R. Etheridge reports that the fossils appear to be of Upper Cambrian age. The crystalline sandstones, quartzites, and conglomerate of which the Thumbs and the Denison Range are composed are believed to be Cambrian.

(3) *Ordovician.*—The slates and sandstones of the goldfields of Lefroy, Mount Victoria, Mathinna, Mangana, &c., in the northern and eastern parts of the island are referred to this system, though few fossils of any stratigraphical value have been found. Their bearing is either east or west of north, and anticlinal axes are long and continuous. The gold quartz reefs which traverse them began to form apparently at the close of the Upper Silurian. Large and important mines have been opened on these reefs, and every geological consideration that can be adduced points to the permanency of the goldfields.

The conglomerates and sandstones at Beaconsfield, together with the blue limestones which prevail in that district at Blyth's Creek and Winkleigh, as well as the Chudleigh and Railton limestones, may be provisionally regarded as of Ordovician age. The Blyth's Creek limestone has yielded imperfect casts of corals, and the Railton quarries contain remains of Actinoceras and other cephalopods.

A series of clay slates occurs between Zeehan and Mount Read, known as the Dundas slates, and believed to be of this age. Ill-preserved traces of graptolites have been noticed in them. These slates extend to Mount Read, Mount Black, and the Red Hills, and along their junction with intrusive quartz porphyry rocks (felsite, keratophyre, granophyre, porphyroid, &c.) large lenses of complex gold and silver bearing sulphide ores of zinc, lead, and copper have been formed.

Another group of rocks at the base of the Ordovician is the Gordon River series of limestones, sandstones, and slates. The limestone in this group is fossiliferous. The organic remains include Favosites, Orthoceratites, Raphistoma, Orthis, Rhynchonella, Euomphalus, Murchisonia, &c. The limestone reappears to the north-east of Mount Farrell, in the bed of the Mackintosh River, a short distance above its junction with the Sophia River. East of the Valley of Rasselas these rocks occur again in the Florentine Valley and at the Junee.

(4) *Silurian.*—The Silurians are strongly developed at Zeehan on the West Coast, at Middlesex, and Mount Claude, Heazlewood, and the Eldon Valley, Queen River, &c.

At Zeehan conglomerates and tubicolar sandstone underlie the limestones, slates, and sandstones, which are intersected by the numerous galena-bearing lodes which have yielded the ore for which this field is so well known.

The fossils found in limestone and quartzite belong to the genera Hausmannia, Asaphus, Illaemus, Cromus, Rhynchonella, Strophodonta, Lophospira, Murchisonia, Eunema, Tentaculites, and the beds are considered by Mr. R. Etheridge to be homotaxially equivalent to the lower portion of the Upper Silurian.

Similar tubicolar sandstone occurs near Bell Mount, Middlesex, and on the Five-mile Rise, and casts of Hausmannia (or Phacops), Rhynchonella, Orthis, and coral have been found.

Clay slates in the Eldon Valley, containing fossil casts of Calymene, Orthis, Cardiola, are considered to belong to the Upper Silurian.

At the Heazlewood limestone and sandstone have yielded remains of Hausmannia, Cromus. Cornulites, Rhynchonella, Tentaculites, and Favosites.

Sandstones and limestones in the Queen River District have been identified as Silurian (Middle or Upper Silurian). These are west of Queenstown. Brachiopods and trilobites have been found also on the east side of the Lyell Razorback, indicating a similar age for rocks on the Lyell and Lyell Blocks mining properties there. The Queen River sandstones are charged with casts of Spirifera and Orthis.

Trilobite-bearing Silurian rocks also occur north of the Pieman River, near the Wilson River.

In the Zeehan field the Silurian slates are largely accompanied by contemporaneous and intrusive sheets and dykes of vesicular melaphyre. The igneous rock corresponds very closely with the German spilite, an amygdaloidal diabase, sometimes called lime diabase.

Massive conglomerates crown most of the West Coast mountains, the Dial Range on the North-West Coast, Mts. Roland, Claude, &c. These have generally been ascribed to the Devonian, but more recent data point to the commencement of the Silurian as more probable, and even a still greater age is possible.

The quartz-porphyries or felsites which form the backbone of the West Coast Range are the geographical axes of Mts. Darwin, Jukes, Huxley, Tyndall, Read, Murchison, and Farrell. They carry copper ore associated with lenses of hematite and magnetite, chloritic and felspathic copper-bearing schists, some of them probably schistose porphyries, flank them and are enclosed in them. The felspathic schists of Mt. Lyell belong to this group. Sufficient is not known of this geological formation to enable its age to be stated definitely.

Associated with the rocks of the Silurian system in the northern and western parts of the island is an extensive development of serpentine, the altered form of gabbro and its appendages, peridotite and pyroxenite. This rock is found in the Heazlewood district, at Trial Harbour, in the Dundas district, in the Forth Valley, and near Beaconsfield. The difference of age between it and the Devonian granite is slight. Chronologically some of the granite is later.

(5) *Devonian.*—Granite occurs in a meridional line down the East Coast, extending from Flinders Island to Maria Island. It forms Mt. Cameron, Mt. Stronach, the Blue Tier, Freycinet's Peninsula, and is exposed at Ben Lomond and at the base of Mt. Arthur. Exposures are also seen at the Hampshire Hills, Granite Tor, Middlesex, the Magnet and Meredith Ranges, Heazlewood, &c. The quartz-porphyry dykes at Mt. Bischoff, the tourmaline lodes at Mt. Black and in the Dundas district, the stannite lodes and quartz porphyry dykes at Zeehan, all denote a granitic reservoir below a large portion of the mineral fields of the West Coast. No granite intrusion into Permo-Carboniferous strata has been observed. The normal granite is a dark mica one, but muscovite and lithia micas appear in the tin-bearing varieties. Tin-bearing lodes occur on Ben Lomond

and Mt. Heemskirk, while on the Blue Tier floors or stocks of altered granite form huge tin ore-bodies of low grade. Porphyry dykes at Mt. Bischoff have shed the vast accumulation of tin ores which has been mined by the Mt. Bischoff Company for the last 34 years with wonderful success.

(6) *Permo-Carboniferous.*—The base of the system is formed by glacial conglomerates, grits, micaceous sandstones and flagstones, well seen on Bruni and Maria Islands and elsewhere in Southern Tasmania. Fossiliferous mudstones and limestones form a lower division of the system, while the upper division comprises the Tasmanite shale and coal measures of the Mersey Basin, with upper marine mudstones and shales in the Mersey Basin and at Hobart, and the coal measure series of Mt. Cygnet and Southport. The characteristic fossil plants of the coal measures of this system are Glossopteris, Gangamopteris, Noggerathiopsis. The seams average from 1½ to 2 feet in thickness, and the analyses show from 36 to 42 per cent. fixed carbon, 41 to 48 per cent. gas, 2 to 9 per cent. ash, and 8 to 12 per cent. moisture. They are known as the lower coal measures of Tasmania.

South of Wynyard and at Barn Bluff cannel coal or kerosene shale is met with. The Wynyard or Preolenna seam of this coal is in sandstone, overlying fossiliferous mudstones, and assays up to 76 per cent. volatile matter. The Barn Bluff cannel coal has only been observed in loose blocks, supposed to have been disturbed by glacier action.

At the close of the system, or during Mesozoic times, a local intrusion of alkaline rocks, alkali and nepheline syenites, &c., occurred, traversing the Permo-Carboniferous strata south of Hobart, from Oyster Cove and Woodbridge on the Channel to the Huon River in a N.E.-S.W. line.

Auriferous quartz and pyrites have been developed near the line of contact of these igneous rocks with the Permo-Carboniferous sandstones and mudstones, and a good deal of free gold has been shed into the flats.

(7) *Mesozoic.*—The fresh-water beds, which succeed the Upper Palæozoic, belong to the Mesozoic division, but cannot as yet be subdivided with certainty. The nearest approach to a subdivision would be as follows, but the reference to European equivalents is nothing more than an attempt at correlation homotaxically:—

(*c*) Cretaceous (?)—
4. Diabase in intrusive masses, sills, and dykes.

(*b*) Jura (or Rhætic)—
3. Upper coal measure sandstones.

(*a*) Trias (?)—
2. Sandstones and shales with coal at Ida Bay.
1. Variegated sandstones with remains of heterocercal fishes and amphibians.

The variegated sandstones occur at Knocklofty, the Domain, Ross, &c. Remains of Adrolepis have been found at Knocklofty and Tinder-box Bay. Bones of an amphibian (labyrinthodontine?) have been obtained from the Government House quarry in the Domain.

The upper sandstones are readily recognised by their soft felspathic nature. They are generally greenish-grey to yellow-

ish-brown, sometimes white. They are widely distributed throughout Eastern and South-eastern Tasmania, and occur also in the extreme south. They are largely interrupted by intrusions of diabase. They flank the central, eastern, and western tiers, and fringe isolated mountains, *e.g.*, Mt. Nicholas, Mt. Victoria, Ben Lomond, Ben Nevis, Mt. Dundas, Cradle Mountain, &c. From Fingal and Mt. Nicholas they extend on the outskirts of the diabase ranges southward to Seymour, Bicheno, Llandaff, Spring Bay, and all over South-eastern and a large part of Southern Tasmania.

These measures enclose the coal seams, averaging from 4 to 12 feet, which are worked at Mt. Nicholas, Cornwall, York Plains, and Sandfly collieries. The analyses of this coal range from 53 to 60 per cent. fixed carbon, 23 to 31 per cent. volatile matter, 9 to 16 per cent. ash, 2 to 4 per cent. moisture, and the coal is not a coking one. A sub-anthracite coal is raised at York Plains, and at the Sandfly Mine a seam of anthracite occurs containing 80 per cent. fixed carbon and 8 per cent. volatile matter.

The fossil flora from these measures must be regarded as characteristic for the Mesozoic. The list includes Thinnfeldia, Pecopteris, Tæniopteris, Sphenopteris, Alethopteris, &c.

The diabasic intrusions cut up the coal measure areas into different basins, and cover large portions of the Central, Eastern, and Southern districts.

(8) *Tertiary.*—A great stratigraphic break exists between the Mesozoic and the succeeding strata. This Tertiary system cannot be subdivided as in Europe. Two divisions, Palæogene and Neogene, are adopted in Tasmania. According to this arrangement the subdivisions are as follows:—

(*a*) Neogene (= approximately to Pliocene).
Under this head would fall various river terraces and estuarine deposits.

(*b*) Palæogene (= Eocene to Miocene).

3. Basalt lavas.
2. Fluviatile and lacustrine clays and sands, tin ore drifts, and deep leads.
1. Fossiliferous marine beds at Wynyard (= Eocene).

The marine fossiliferous beds at Wynyard are covered with the basalt which, generally throughout the island, appears to separate the Lower from the Upper Tertiaries. The extensive lacustrine deposits within the watershed of the Tamar cover an area of 600 square miles, and embrace widely-spread pre-basaltic or Palæogene clays and sands, which form a series 900 to 1000 feet thick. Such sediments with fossil leaves of European genera occur at Launceston, Dilston, Windermere, Beaconsfield, Waratah, Strahan, St. Helens, Burnie, and on the Derwent. In the north-east and east the sub-basaltic gravels are worked on a large scale for tin ore, and yield most of the alluvial tin of the State.

At the close of the Palæogene a great outpouring of basaltic lava took place, and this rock is very general throughout the island, though rarer on the West Coast.

The rock is usually olivine basalt, but nepheline basalt occurs on the Shannon Tier, and at Sandy Bay, Hobart.

The Neogene valley terraces can only be distinguished from the earlier Tertiaries by position and lithological characters. Some of the gravel drifts of the Derwent, of the Longford Plains, and in the neighbourhood of Launceston belong to this subdivision. The close of the Tertiary, or the beginning of the Quarternary, witnessed a glacier epoch in the west and centre of the island. The highlands round Barn Bluff, Mts. Tyndall, Lyell, Sedgwick, Jukes, Darwin, &c., and the western edge of the great central plateau abound with tarns, ice-scratched stones, and moraines. No proof of glacier condition in this period in the eastern part of the island has been adduced yet.

Tin and gold ores are the most important products of the deposits of the Tertiary system. They are won from the alluvial gravels and leads of the period. The sands in the Savage River and other tributaries of the Pieman and Huskisson have been worked for osmiridium. Zircon sand, near Table Cape, has also been exploited. Tertiary clays are used largely for brick-making and pottery, the gravels for road-making. Lignites exist, but are not yet industrially important. Though there has been great volcanic activity, there are no signs of Tertiary metalliferous veins.

(9) *Quarternary.*—These deposits may be classed as follows:—

(*b*) Recent.

3. River alluvium and sand dunes.
2. Raised beaches and helicidæ sandstones.

(*a*) Pleistocene.

1. River drifts.

The later terrace drifts in the valleys of existing rivers are referred to the Pleistocene. Sand dunes, consolidated to shelly sandstones, occur on Cape Barren, Badger, Kangaroo, and other islands in Bass Straits, containing shells of helix, succinea, &c. These sandstones sometimes overlie a raised beach. The raised beaches on the North and South Coasts indicate elevation within the Recent period. Some of the glacier phenomena may belong to the Pleistocene, and have continued even to the Recent period.

(10) *Ore-deposition.*—The period during which the deposition of metalliferous ores was most active was the interval between the Upper Silurian and Permo-Carboniferous. Ore-deposition has been associated principally with the consolidation of the gabbroid and granite masses. Nickel sulphide and osmiridium owe their origin to the serpentine at the Heazlewood, Trial Harbour, and Dundas. On the other hand, the granite magma is responsible for the lodes of silver-lead all over the island, whether these pierce quartz-porphyry, as at the Devon and Mt. Tyndall, slate, sandstone, and limestone, as at Zeehan, or ultra-basic dyke rock, as at the Magnet. The pyritic lead, zinc, or copper ores of the West Coast Range (Mt. Lyell, Mt. Read, Mt. Black, &c.) are also most probably due to the action of the acid magma. Tin and wolfram ores are naturally referred to the same source, and the quartz reefs of the Ordovician strata must

be regarded as the result of the expiring effort of the cooling magma to get rid of its surplus available silica. A few veins of barren quartz occur in the Permo-Carboniferous strata, but beyond the exceptional case of the alkali porphyries at Port Cygnet, the chapter of metal-bearing lode action closed, as it began, with the Devonian period. Within that period, therefore, were accumulated the great stores of mineral which the mining industry of Tasmania is now drawing upon. The mines of gold, silver, lead, copper, and tin rank high among the famous mines of the world. Her mineral wealth may, in fact, be considered remarkable when, despite the small area of the island (26,000 square miles), the value of the mineral produced for the year ending 31st December, 1907, amounted to £2,277,159. The industry is thriving, is on a sound and established basis, and with the careful administration and care which it receives it may with confidence be expected to continue a highly important asset of the State for a quite indefinite period of time.

ON AN ENSTATITE-AUGITE BEARING DIABASE FROM TASMANIA.

By A. Osann, Freiburg. (1)

[Translation by W. H. Twelvetrees, Government Geologist.]

As an annex to W. Wahl's interesting investigations of enstatite-augite in diabases, (2) the author here describes a diabase from Launceston, Tasmania, which he has received from Professor F. W. E. David, of Sydney. According to Johnston's geological sketch-map of Tasmania, (3) greenstones (diabase, otherwise dolerite) have a very wide distribution in this island; they compose in particular a considerable part of the mountainous land of the centre, and spread also to the northern, eastern, and south-eastern coasts. Their occurrence is always associated with Carboniferous and Mesozoic sedimentaries, with which apparently they alternate as intrusive masses. Twelvetrees and Petterd (4) give a general petrographic description of them, and see in them close relationships to the Hunne and Kinne diabases. F. P. Paul (5) has described a konga diabase from the neighbourhood of Hobart, in the southern part of the island. The rock contains, always in parallel intergrowth, two pyroxenes of somewhat different colour and of different optical axial angle; closer information respecting the size of the latter is not given.

Further information respecting the geological occurrence of the diabase now to be described is not in the author's possession.

It is a medium-grained, very fresh rock, of grey colour, with macroscopical pyroxene and lime soda felspar; the former forms irregularly bounded grains or thick (up to 6 mm.) long rods of bright greenish-grey colour. Ophitic structure is not developed. Under the microscope also the diabase appears to be very fresh, and composed essentially only of felspars and pyroxene; amphibole and mica are altogether absent. The plagioclase has quite the habit of andesite felspars. Crystographically it is always very well developed, in thick plates parallel to (010), and then elongated in the direction of the *a* axis. Sections show the combination (010) (001) (110) (110) (101) (201). Twinning lamellation, according to the albite law, is probably present in every individual; and is frequent according to the pericline and Carlsbad laws. Zonal growth is universal, and this appears

(1) Central blatt für Mineralogie, Geologie, und Paläontologie, 1907, No. 23. pp. 705–711.

(2) W. Wahl: Die Enstatitaugite, Mineral. petr. Mitteil, 26. p. 1.

(3) R. M. Johnston: Systematic Account of the Geology of Tasmania, 1888.

(4) W. H. Twelvetrees and W. F. Petterd: On Mesozoic Dolerite and Diabase in Tasmania. Proc. Roy. Soc. of Tasmania, 1898-9.

(5) F. P. Paul: Beiträge zur petrographischen Kenntniss einiger foyaltisch theralitischen Gesteine aus Tasmanien. Mineral. petr. Mitteil. 25, p. 267.

particularly in sections parallel to (010). A basic centre is surrounded by an acid envelope, which is sometimes furnished with a narrow, more acid, marginal band. The boundaries of these zones are generally sharp. The following measurements were taken on (010), observing crystallographic contours and orientating for uniform brightness:—

Centre.	Envelope.	Marginal Band.
$-33\frac{1}{2}° = Ab_{11}\ An_{89}$	$-18\frac{1}{2}° = Ab_{46}\ An_{54}$	
$-29\frac{1}{2}° = Ab_{25}\ An_{75}$	$-21\frac{1}{2}° = Ab_{42}\ An_{58}$	
$-34\frac{1}{2}° = Ab_{7}\ An_{93}$	$-23\frac{1}{2}° = Ab_{40}\ An_{60}$	
$-33\frac{1}{2}° = Ab_{11}\ An_{89}$	$-22° = Ab_{41}\ An_{59}$	
$-35° = Ab_{5}\ An_{95}$	$-19° = Ab_{46}\ An_{54}$	$-19° = Ab_{55}\ An_{45}$
$-30° = Ab_{24}\ An_{76}$	$-20° = Ab_{44}\ An_{56}$	$-18° = Ab_{54}\ An_{46}$

Accordingly, the centre is basic bytownite-anorthite, the envelope is labradorite, and the narrow outer band is basic andesine

Under the microscope the pyroxene is very brightly coloured. In thin mounts the larger grains are, as a whole, nearly colourless, only on the edges a more intense grey-brownish tint is apparent. Small grains have also the same colouration. Pleochroism is scarcely perceptible, even in very thick slices and isolated grains. Crystallographic boundaries are infrequent, and confined to the prism zone. As a rule well-defined felspars pierce the larger pyroxene grains, and small grains of augite with irregular forms are squeezed between the felspars. Obviously, the crystallisation of pyroxene began before that of the felspars, but that of the latter lasted longer than that of the former. On this account, and also in consequence of the presence of a felspathic mesostasis, the structure deviates from a purely ophitic one. Besides a prismatic cleavage there is one parallel to (010), apparent by means of infrequent, but clean and continuous, cracks. Parting parallel to (001) can be recognised only in places. The cracks corresponding to this face are always crowded together in spots, and never traverse an entire pyroxene section. A twinning connected with these striæ is not shown. Frequently the parting proceeds from large prismatic cleavage cracks, and at the same time there begins an alteration of the pyroxene to green decomposition products; according to this it is certainly to be regarded as secondary.

The augite acts as a host for numerous inclusions of small dimensions. The smallest of these are colourless, rounded, and frequently carry a moving gas-bubble. The larger ones are cloudy, sometimes scarcely translucent, apt to be drawn out in tubular form, and constitute in places a complete network. Apparently these also are fluidal inclusions. Their decomposition is irregular; they collect in swarms, so that with a low magnifying power their host appears as if traversed by irregular cloudy zones. With striking frequency these zones occur in the vicinity of large cracks, so that for these inclusions also a secondary origin is probable.

Grains of pyroxene are often intergrown with one another polysomatically, as can be seen even in ordinary light along the course of the cleavage cracks. In polarised light, however, another phenomenon appears: Grains of uniform cleavage, which in ordinary light, both in respect of colour and refraction, appear perfectly homogeneous, fall into generally two, rarely

several, individual parts, which differ by reason of a slight dissimilarity in the strength of double refraction or position of the directions of vibration. The boundaries of these individuals are always sharp, and are irregular, as is their mutual relation, so that any difference in age is not apparent. Each of the individual parts can extend to the margin of the entire section, and assume there a deeper colouration. Sometimes the whole phenomenon recalls such as is shown by strongly-squeezed and shattered quartz grains; a similar feeble undulose extinction declares itself. Nevertheless, secondary pressure is here certainly not the cause. The rock, moreover, shows no trace of pressure effects, and the course of this phenomenon in neighbouring pyroxene individuals cannot be referred to any common direction of pressure.

The optical differences are best seen in weakly birefringent sections. With a favourable section approximately normal to the acute bisectrix, one kind of these individuals (for brevity named pyroxene *A*) shows a grey polarisation colour, while the other (pyroxene *B*) remains completely dark. In convergent light *A* gives the figure of a biaxial crystal with a moderate, but in different grains, a somewhat variable axial angle; with *B*, on the other hand, the cross either does not open at all, or only slightly, and in a plane normal to the axial plane of *A*. One can best convince oneself of the latter by choosing a spot in the neighbourhood of the boundary between two individuals, *A* and *B*, and placing the mount at 45° push it. Just as the boundaries of *A* and *B* appear sharp in parallel light, so here also the passage from one position of the axial plane to the other is immediate and with a leap. The position of the bisectrix *C* is apparently exactly identical in both individuals. Since their intergrowth, as is shown by the coincidence of both systems of cleavage cracks, is parallel, one of them must have a normal-symmetrical axial position. From the angle of the cleavage cracks, and in the case of twins on (100), from the position of the twinning plane it is seen that *A* has symmetrical, *B* normal-symmetrical, axial position. This is a further instance of normal-symmetrical axial position in pyroxene, as described by Wahl in the augites of the diabase of Richmond and the eucrite of Juvinas. Unfortunately very few sections were suitable for measuring the axial angle. In a very thick slice two intergrown grains were measured with a Klein's lens: *A*, 2E = 45 – 46°; *B*, 2E = 12°. Accordingly, for a monoclinic pyroxene, *A* has a strikingly low value, which, according to Wahl, is characteristic of diabase augites poor in lime.

With increasing birefringence the optical differences between *A* and *B* diminish, and sections on (010) allow only slight differences in polarisation colour to be noticed, but none in the extinction. The latter amounts to C : C = 45 – 46°. On cleavage flakes on (110) the extinction was found varying between 31° and 35°, but it was impossible to determine whether it was different between *A* and *B*.

The attempt to separate the pyroxenes *A* and *B* by means of heavy solutions was unsuccessful. In the Rohrbach solution, in which epidote of 3·47 sp. gr. just sank, the augite began also to sink, and the microscope showed this to belong to the dark marginal zone. The clear grains sank within a very small interval of dilution, and the irregularly distributed fluidal inclusions evidently exert a greater effect on the specific gravity of their

hosts than the anticipated chemical differences of *A* and *B*. Nothing remained therefore but to analyse the clear pyroxene by itself, *i.e.*, as a mixture of *A* and *B*. The analysis (by Professor Dittrich) gave the following results under I. Under Ia. are the corresponding molecular quotients:—

	I.	II.	III.	Ia.
$Si\ O_2$	51·87	51·30	50·36	0·8588
$Ti\ O_2$	0·21	0·72	0·80	0·0026
$Al_2\ O_3$	2·02	2·36	2·49	0·0198
$Fe_2\ O_3$	3·50	2·22	2·35	0·0219
Fe O.....	8·98	18·83	18·15	0·1249
Mn O	0·18	0·57	0·56	0·0025
Mg O.....	16·26	16·56	11·37	0·4029
Ca O.....	15·70	6·96	13·97	0·2797
$Na_2\ O$	0·16	0·21	0·26	0·0026
$K_2\ O$.....	0·09	0·37	0·19	0·0010
$H_2\ O$	1·20	1·00	0·55	
	100·17	101·15	101·09	

II. and III. are quoted for comparison. Under II. is the composition of a pyroxene from the diabase of Källsholm, Föglö (with 0·05 Nio). According to Wahl the apparent angle of the optic axes varies between 36° and 26°; the average is 30°. Under III. is the composition of a pyroxene from a coarsely granular quartz diabase from Schtscheliki (with 0·04 NiO), with 2E between 73° and 40°, greater therefore than that of II. In both occurrences the greater and smaller values are, contrary to our pyroxene, connected by transitions in one and the same individual.

The low lime content, as well as the optical characters, prove that our pyroxenes, *A* and *B*, belong to the enstatite-augite series of Wahl. According to the optical relations a still lower content was to be expected. Strikingly low is the percentage of FeO. Wahl found the proportion CaO : FeO + MgO in various enstatite-augites to be very nearly 1 : 6, and sees in this diminution of CaO as against the total of the other two oxides the factor which mainly conditions the small axial angle. At all events, that is correct. Still, the proportion of FeO : MgO, as in rhombic pyroxenes, must also exert a not unessential influence on this angle, respecting the importance of which we are still quite in the dark. In Analysis I. the proportion CaO : MgO + FeO is nearly as 1 : 2. Alkalies and sesquioxides vary so little in the analyses given that their influence on the axial angle seems to be inconsiderable. Owing to entire ignorance of the proportions of their admixture, nothing further, of course, can be established as to the chemical differences between the *A* and *B* pyroxenes of the Tasmanian diabase.

The high water content in Analysis I. is striking. Before the water was determined, which was done by Penfield's method, the powdered mineral was dried two hours at 105°. Hygroscopic water to the extent of 1·20 per cent. is therefore excluded. Hydrous decomposition products could not be determined microscopically in the powder, and only traces of them are recognisable in slides of the pieces of rock used for isolating. It is questionable whether the plentiful, but very minute, fluidal

inclusions can be made responsible for this amount of water. Perhaps one might suppose a primary]-(content in the pyroxene.

As already mentioned, the structure of the rock is not typically ophitic, notwithstanding the very late age of the pyroxene. A mesostasis occurs in areas of meshwork, which, as can be seen in thin slides, consists of two colourless minerals, distinguishable by somewhat differing refraction and double refraction. The mineral with stronger refraction and double refraction forms either radiating aggregates or irregularly outlined spots, which, as a rule, have uniform optical orientation in one meshed area. It agrees in refringence and birefringence with the acid margin of neighbouring plagioclase crystals, and attaches itself to these with identical orientation. According to this, it is andesine. The other mineral, in which this andesine is embedded, might, in harmony with the not inconsiderable potash content of the rock, be orthoclase. Quartz appears to be entirely absent.

The sparse iron oxide is attracted by the magnet; but according to the titanic acid content of the total analysis, which considerably exceeds that of the pyroxene, it must be titaniferous.

The analysis of the diabase, also by Professor Dittrich, gave as follows:—

	I.	II.
SiO_2	52·49	56·14
TiO_2	0·62	0·49
Al_2O_3	16·44	10·35
Fe_2O_3	2·60	—
FeO.....	5·30	6·81
MnO	trace	—
MgO	6·18	9·92
CaO.....	11·71	13·42
Na_2O	2·06	2·13
K_2O	1·09	0·74
H_2O under 110°.....	0·15	
H_2O under 110°.....	1·42	
P_2O_5	trace	
	100·06	

From the molecular ratios given in column II. (all iron calculated as FeO) results follow as under:—

s	A	C	F	a	c	f	n	m	k
56·5	2·87	7·48	22·67	2	4·5	13·5	7·4	7·4	1·03
58·	3·38	6·39	22·34	2	4·	14·	7·7	8·6	1·05

In the bottom row the corresponding values are quoted from Wahl; for the diabase already mentioned from Källsholm on Föglö. On the whole the figures for *A*, *C*, and *F* are very similar. The silica coefficient of Föglö is somewhat higher than that of Launceston; the former rock contains some quartz. In Launceston the lime soda felspar, with a very little basic andesine, is essentially labradorite, with bytownite, down to anorthite; in Föglö it is labradorite, with only sporadic grains of bytownite. This finds expression in the ratio A : C, and also in the values *a* and *c*. The pyroxene of Föglö contains only 7 per cent. CaO, compared with that of Launceston, 15½ per cent. Therefore, *m* in the former is considerably higher than in the latter. The alkali ratio (*n*) is nearly the same in both rocks, therefore one should expect some orthoclase also in that of Föglö.

REPORT ON THE BELL MOUNT AND MIDDLESEX DISTRICT.

Government Geologist's Office,
Launceston, 17th June, 1907.

SIR,

I HAVE the honour to report that, in pursuance of instructions, I proceeded to this district on the 5th March, with the view of examining the deposits at present being proved or exploited by the mining companies of the field.

There are two routes of access to the district. The Mole Creek-road, *viâ* Liena and Lorinna, leads to the south end of the district over a distance of 20 miles to 25 miles. At present the field is more easily accessible *viâ* Sheffield and Wilmot. The coach takes the traveller from the Railton railway station to Sheffield, 8 miles; thence a mail-cart runs to Wilmot, 11 miles. A partly-made road is passable in fine weather by spring-cart or bullock teams from Wilmot to the Shepherd and Murphy Mine, 11 miles, or about 14 miles to the Bull Plain selections, after which the track is used by pack-horses for 5 miles to the Devon Mine on the Dove River.

Sheffield is on the high plain of Tertiary olivine basalt 900 feet above sea-level, with Mt. Roland to the south forming a rugged, picturesque mass, rising to 3100 feet above Sheffield. The run to the Forth Valley is through gently undulating country covered with the cultivated fields of thriving settlers. The chocolate soil, derived from the rapid waste of the basaltic lava sheet, is highly favourable for crops of oats and potatoes.

The older rocks are first seen on descending into the valley of the Forth. This river has carved out a deep gorge-channel down through the basalt capping into underlying sandstones, quartzite, and conglomerate of undetermined age. The bridge over the river here is about 200 feet above sea-level. The road then rises 600 feet to the township of Wilmot, bringing the traveller again on the basaltic sheet.

Wilmot, 11 miles from Sheffield, is the centre of a district with a present population of 800, which is rapidly increasing. Seven years ago dense scrub covered the site of the present township, but it is now a thriving little place, with school, store, bakery, post office, two boarding-houses, and a butter factory which is supplied by two

thousand cows. All the ore from the mines passes through Wilmot to Devonport, the Devon Company having to pay £3 19s. 6d. per ton, and the Shepherd and Murphy £2 12s. 6d. per ton. The freight of potatoes from here to Devonport is £1 per ton. This myrtle land is all taken up on the divide between the Forth and Wilmot Rivers by sturdy, independent farmers, who are busy scrubbing and dairying, and are laying the foundations of a thriving pastoral and agricultural industry. It is not pleasing to see the great destruction of timber which necessarily goes on in the absence of a railway, which would enable it to be conveyed to other parts of the State where it would be used. Considerable divergence of opinion as to routes prevails in Barrington, Sheffield, and Wilmot, and the disagreements on this question have perhaps helped to retard decision on this matter; but if the West Coast is ever to be connected with this part of the island by a direct trunk-line from Mt. Farrell or Rosebery to the Mersey, the most direct and useful connection with the mineral country would be through Wilmot.

The enterprise of the Wilmot settlers, moreover, has advanced the question of route considerably within the last year or two, and is also now making out pretty clearly the direction in which settlement is destined to extend. Land is now taken up all along the south road from Wilmot to the V.D.L. track, at the Caledonia Mine, a distance of 17 miles, and selections are extending from this road in a westerly direction down into the valley of the Iris River and up to the boundary of the Middlesex Plains block. It is impossible to withhold admiration of the energy with which this great tract of waste uninhabited land is being reclaimed for the service of man. The only caution necessary is to see that in the eagerness and rush mineral-bearing land is not alienated, as there is reason to fear has happened in the past.

The road rises to an elevation of 2000 feet above sea-level at Bell Mount (so-called from its shape as seen from the Sheffield side), and after passing the Shepherd and Murphy Mine, to which a branch road descends, maintains a general height of 2300-2500 feet as far as Bull Plain, after which it rises gently between 100 and 200 feet to the old Caledonian camp on the V.D.L. Middlesex track. South of this track is the stupendous gorge of the Dove River, which has cut its channel down 1600 feet below the level of the surrounding country, and flows, a clear stream with much noise and force, at the bottom of

the valley. The heavily timbered sides and precipitous granite cliffs between which the rushing river pursues its headlong course combine in producing a scene of wild, rugged beauty which stamps itself indelibly on the traveller's mind and memory.

Geology.

The field as a whole consists of Silurian strata overlaid in parts by Tertiary basalt, and penetrated by granite and quartz-porphyry usually considered to be of Devonian age. Still older rocks (pre-Silurian) occur at Bell Mount.

Time did not permit me to visit Mt. Roland, which is a few miles south of Sheffield, and is capped by conglomerate and red sandstone dipping away gently to the south. Mr. G. A. Waller reported that the bed-rock underlying the conglomerate at Mt. Roland is syenite. This has a very important bearing on the vexed question of the age of the conglomerates which so frequently form the summits of the mountain ranges of the West and North-West Coasts. This question is not so much whether they are Upper Silurian or Devonian, for we have nothing to guide us in this respect, as whether they are prior or subsequent to the consolidation of our metal-bearing granites. The fact that on Mt. Roland the conglomerate reposes on the granitic rock is suggestive of the intrusion, and therefore later age, of the latter, because it can hardly be supposed that the interval of time available would have been sufficient for the denudation of the country down to the horizon of the plutonic rock. Once, however, admit that the granite was intrusive into the conglomerates, and the search for ore-deposits in the latter need no longer be regarded as a vain quest. The hardness of the rock may be an unfavourable feature, but veins of quartz do occur in these conglomerates, and gold, *e.g.*, at Black Bluff, is associated with them.

Mr. G. A. Waller records Rhynchonella casts from the conglomerate series on the east slope of Mt. Jukes identical with the Upper Silurian specimens from Zeehan. I have recently received from Mr. Hartwell Conder, M.A., a tubicolar fossil cast from the conglomerate on the peaks of Mt. Lyell similar to those found in the fossiliferous sandstone at the Lyell Blocks Mine, and frequent also in the Silurian strata of the Middlesex district. These occurrences make the pre-granite age of the conglomerates very probable.

An outcrop of quartzite is seen on the road from Wilmot, on A. C. Hall's farm; also yellow sandstone. This in all probability belongs to the Silurian. On the south boundary of the Parish of Narrawa the basaltic soil is left at Sloane's farm, and the series of ancient schists, flagstones, sandstones, and quartz-porphyry begins. These form the hill known as Bell Mount, round the eastern and southern flanks of which the road winds, exposing the edges of the strata at about 2000 feet above sea-level. Thinly-bedded purple flagstones or arenaceous slates strike N.W.-S.E., almost vertical or with a slight dip to the north-east. These are followed by hard pink sandstone and a brown schistose quartz-porphyry.

The Bell Mount flags and porphyry are the oldest rocks in the district. They are almost certainly pre-Silurian, but nothing more definite at present can be said about their age. Quartz veins occur in them, and indications of copper ore exist. These strata form a belt which evidently extends a little to the south, for similar rock has been observed on the Narrawa section, but it is cut out further south by the Silurian sandstones and granite.

After leaving the schist belt alternating exposures of Silurian sandstones and Tertiary basalt occur. Just where the branch road goes off to the Shepherd and Murphy Mine on W. D. Weston's block is quartzite, which disappears under the basaltic covering going south. The main road passes over the basalt in the north part of Section 1332, T. J. Clerke, but then enters the Silurian sandstones and quartzite country for the remainder of that section and the one immediately south, when high basaltic land supervenes and continues south as far as R. Quail's 104-acre section. At the creek south of this similar Silurian sandstones and conglomerates continue as far as the edge of the Dove River Gorge.

The sandstone, with characteristic fossil casts and impressions, extends, with interruptions by granite and quartz-porphyry intrusions, over the Shepherd and Murphy and All Nations sections, where it carries tin and wolfram lodes. It is seen at the Caledonian camp and along the Five-mile Rise, as well as on Mt. Claude on the east side of the Forth. It is often hardened into a white quartzite. The most abundant fossil or impression of some organic remains is what is locally called "pipe-stem," somewhat resembling in form a part of the stem of an ordinary clay pipe. These are sometimes a foot in length, and slightly curved. They lie in all directions, sometimes

parallel with the bedding, sometimes vertical, and project from the surfaces of weathered stones, though their substance is wholly made up of quartz grains, and no structural parts have been preserved. Mr. Robt. Etheridge, of the Australian Museum, Sydney, to whom I submitted specimens, had thin sections prepared for microscopical examination, but in the absence of any signs of structure could not undertake to say what the specimens might represent. The forms which they most resemble appear to me to be the dwelling-tubes constructed by some tubicolar annelides, and if we must give the rock some more definite name than "pipe-stem," I should think that tubicolar sandstone would be a convenient one for the time.

Dr. Noetling, late paleontologist on the Geological Survey of India, to whom I showed the rock, also thought this interpretation a probable one. The same organisms occur at the base of Mt. Zeehan in similar white sandstone underlying conformably the fossiliferous limestones, sandstones, &c., of the Zeehan mining field, which, from Mr. Etheridge's determination of the fossils, are established as of Upper Silurian age. According to Mr. Waller's ideal section of Mount Zeehan, this tubicolar sandstone overlies the conglomerate, which he regards as the basal formation of the Upper Silurian. Examination of the conglomerates in different localities is needful before any general statement can be propounded with confidence, but meanwhile evidence of a close association between the two series is accumulating. This sandstone forms such an excellent stratigraphical horizon that its relations with its associated beds become very important for Tasmanian geology, and no opportunity of examination of it or the conglomerates in different places should be lost.

Mr. Waller sent some of the other fossils collected from this rock near Bell Mount and at the Five-mile Rise to Mr. R. Etheridge for determination, and as his identifications have not yet been published, I place them on record. Mr. Etheridge says:—

"The trilobite consists of the thorax and pygidium of one of the Phacopidae, either Phacops proper or Hausmannia, but without the cephalon (or head) it is difficult to say which.

"The Rhynchonella I believe to be R. borealis, v. Schlotheimii of the Middle and Upper Silurian.

"The remains in the yellow mudstone from the vicinity of Bell Mount are two: one is the surface cast of the

corallite mouths of a monticuliporid coral, but in this condition unnameable; the other is the impression of the valve of an Orthis of the type of O. calligramma, Dalman, of Middle Silurian age."

The sandstone and conglomerate formations extend westward across the Iris River, the higher ground at Stormont and Black Bluff being conglomerate. In the Bismuth Creek below the Shepherd and Murphy Mine, on Mr. T. J. Clerke's Section 2853, a dark limestone crosses the stream, and more of this rock is seen on A. C. Hall's section, 237 acres, towards the Iris River.

On the Shepherd and Murphy Section 1437-91M, under the battery and extending south up the hill, is a bed of wollastonite-epidote rock much charged with magnetite and intersected freely by veins of a flesh-coloured lime silicate mineral which has not yet been accurately determined, but which appears to be wollastonite. A tin-wolfram-bismuth lode passes through this bed, which is conformable with Silurian quartzite and sandstone (the tubicolar sandstone). The bed must have originally been limestone, and is a striking sample of contact metamorphism, the substance of the rock with the newly-formed lime minerals (wollastonite, epidote, vesuvianite, diopside, garnet, being the result of silication of the original limestone. The iron may be due to one of two processes, named by von Hise, either deposition from solutions carrying carbonate of iron, or the incomplete oxidation of the ferrous iron of the new silicates. Or there is the direct contact theory, according to which the iron is supposed to have been derived in solution from the granite associated with the gases or solutions which have permeated the sedimentary rock and caused its metamorphism. The nearest exposure of granite rock at the Shepherd and Murphy is the quartz-porphyry in the south-east corner of Section 2134-91M, which no doubt underlies the field, and is responsible for the metamorphism.

A belt of quartz-porphyry and granite stretches across the country from west to east on the southern half of Section 949M, T. J. Clerke, on Section 950M, H. Conder, on part of Section 1037-M, E. W. Clarke, across the Dalcoath sections and the blocks south of the Narrawa Creek to Mt. Claude. It reappears a couple of hundred feet down the Dove River Valley, and continues across the river till it meets with the ancient mica schists. There is reason therefore to believe that granite or quartz-por-

phyry exists at no great depth below the surface, between the Shepherd and Murphy and the Caledonian Mine.

The granite is everywhere to be regarded as the factor governing the mineralisation of the rocks in this field. Although lodes may be met with in the sedimentary strata, the metals which they contain (tin, wolfram, bismuth, molybdenite, copper, lead, gold, silver) obviously had their source in the granite magma. Vogt's views of the formation of tin veins still represent those most generally held, viz., that they originated during the consolidation of granite or immediately afterwards, and that the genetic process consisted in an extraction from the siliceous magma by means of hydrofluoric and hydrochloric acids of fluorides of silicon, tin, boron, and lithium.

The solution was pneumatolytic, the substances existing as gases contained in solutions, and ascending in existing channels in which the deposition of the metals took place. The wall rocks were usually metasomatically altered at the same time.

The deposits which are met with in the district may be classified as—

1. Pyrito-spathic lead veins—Devon Mine.
2. Pyritic lead veins—West side of Bell Mount.
3. Quartz-topaz, bismuth-wolfram-cassiterite veins—Shepherd and Murphy.
4. Quartz, bismuth-tungsten veins—All Nations.
5. Tin-bearing stockworks in granite and quartz-porphyry—Dalcoath and All Nations.
6. Cupriferous quartz veins—Narrawa.
7. Pyritic gold quartz veins—Old Caledonian.
8. Alluvial deposits of gold, tin, and wolfram.

Thus, the district is eminently a mineral one, and now that it is being brought more in contact with the settlements of the North-West Coast, prospecting may receive a fresh impulse and fresh discoveries be made.

It would have an important effect on exploration if it could be determined that certain minerals in this district are characteristic of certain horizons. There is, however, nothing to show that any one of the metals affects a greater or less depth than any other.

The silver-lead lode at the Devon Mine is at the lowest depth of any in the field, both absolutely and relatively, viz., 1100 feet above sea-level and 1400 feet below the upper surface of the granite in a quartz-porphyry modification of the granite mass. The minerals of the lode are gold and silver bearing galena and a little chalcopyrite.

The next lowest occurrence which I visited is a formation in granite-porphyry south of the Narrawa Creek, on the fall to the Forth River, sunk upon by Mr. Black. This is about 1600 feet above sea-level. The metals are wolfram, bismuth, molybdenum, and a little gold.

The Narrawa lode has been opened upon in quartzite or indurated sandstone at about the same level as the preceding. The minerals present are silver, chalcopyrite, wolfram, and gold.

The Shepherd and Murphy lodes are in metamorphosed limestone and sandstone (or quartzite), at a height of from 1800 to 2200 feet above sea-level. These carry tin, wolfram, bismuth, and a little molybdenite.

The All Nations lode is in sandstone (or quartzite), at from 2300 to 2400 feet above the sea, and contains wolfram, with a little gold, bismuth, and a minute quantity of molybdenite. In the quartz-porphyry on the same property tin and wolfram are disseminated.

It must be remembered that all the occurrences were once deep-seated, and that present heights above sea-level have no real bearing on the subject. The real datum line in the enquiry is the upper surface of the granite or porphyry. In the case of the Devon Mine the upper surface is 200 feet below the level of the tableland, so that that lode is really being worked at a considerable depth below the boundary of the granite. It is singular that no tin has been discovered in this lode.

With regard to the porphyry at the All Nations it is impossible to say how much of it has been removed by denudation, but having regard to the proximity of the Upper Silurian sediments it is not likely that the quantity wasted away has been considerable, and the lodes in sandstone on that property and at the Shepherd and Murphy cannot be very far from underlying granitic rock.

The conclusion therefore is that superficially the tin and wolfram deposits of the district appear to prevail at no great distance from the boundary-line between the sedimentary and the granitic rocks, penetrating into the granite and porphyry on the one side and into the overlying sandstones on the other.

This does not mean that wolfram or tin ore will necessarily die out as depth is gained, which would be an unwarrantable inference, but simply that in this field, as far as can be seen from the few trials which have been made, tin or wolfram veins most likely to be profitable should be looked for in the porphyries and granite of the

tableland and in the sandstones and quartzites adjacent to these. There is a very widely-spread idea that wolfram pinches and disappears in depth. This distrust is, I believe, largely due to the irregularity of the deposits in general. It is what may be described as a patchy mineral, occurring often in rich bunches with intervening blanks. This irregularity leads to irregular and costly mining, and when a blank is struck confidence in the mine frequently disappears and work is suspended. Thus, wolfram mining, perhaps more than any other, is marked by an abundance of abandoned attempts.

As a compensation in wolfram mining, the vughs and bunchy deposits often yield large quantities of ore.

The same remarks apply to tin ore. Tin lodes are admittedly extremely variable, and there is generally some uncertainty as to the permanence of any particular shoot or pay zone. But the occurrence of a blank should not lead to the belief that the deposit as a whole is exhausted.

Where tin and wolfram are in separate lodes, difficulties in treatment are non-existent; but where these ores co-exist in the same lode, and as at the Shepherd and Murphy Mine with bismuth as well, there is more trouble, as the concentrates have to be subjected to a process of magnetic separation before anything like the full value of the ore can be realised.

The demand for metallic tungsten has fluctuated considerably during the last few years, but has increased recently with its growing applications and uses in industry. It has long been familiar as an ingredient in the steel used for armour-plates, but a great use for it at present is in making the self-hardening steels for lathe tools, enabling lathes to be driven at a much greater speed than when ordinary tool-steel is used. The point seems to be that the friction heat which softens the common carbon steel tool does not affect the tungsten steel. This means a thorough revolution in works plants, and the consequence is that the world is being scoured for wolfram deposits at present. The recently-created motor industry is also absorbing increasing quantities of tungsten steel. A new metallic filament lamp, known as the Zircon-Wolfram lamp, has lately been introduced, and this application will increase the demand still further.

Molybdenum is now being used for the same metallurgical purpose as tungsten. It occurs in minute quantities,

as the sulphide, molybdenite, on the Shepherd and Murphy, All Nations, and Packett's sections, but nothing sufficient to be payable has been discovered.

It is however widely disseminated in the granite and porphyry of the district, and possibly some deposits of value may eventually be discovered.

Shepherd and Murphy Mine.

This property is 12 miles south-west from Wilmot, and comprises the following sections, charted in the name of W. G. Soper:—1802-M, 79 acres; 1437-91M, 80 acres; 1456-91M, 80 acres; 2134-91M, 78 acres; and 187-93W, 5 acres. The mine is on Section 1437, on the northern slope of a hill spur descending to Bismuth Creek. The country to the north, west, and south of the mine is Tertiary basalt, but at the mine itself and across the creek on the east the lava sheet has been denuded, and the Silurian sandstone, or occasionally quartzite, is exposed. Some abrupt cliffs of solid basalt occur in the creek and on the roadside near the bridge, so that it is very evident that this valley must be of considerable age, and has been gouged out again through the basalt sheet, or the present creek crosses the channel of the older one, which was running east and west. At any rate, the old channel was very deep where the bridge is now.

Seven parallel lodes have been discovered on the hill spur, running east and west. Of these, Nos. 2, 4, and 6 are the most important. No. 6 is the most northerly, 600 feet south of it is No. 4 lode, while No. 5 lode is 93 feet north of No. 4. No. 3 lode is 87 feet south of No. 4, and No. 2 lode is 142 feet south of No. 4. No. 1 lode is about 150 feet south of No. 2 lode.

No. 6 is the lode on which most of the work has been done recently. At about 50 feet above the creek at the battery a crosscut adit (No. 3 adit) has been driven 390 feet in a south-easterly direction, intersecting the lode at that distance. From the point of intersection a drive has followed the course of the lode for 350 feet, with a mean bearing of a degree or two south of east. The lode is vertical, or with a northerly underlay if any, and averages about 22 inches in width. Its economic minerals are cassiterite, wolframite, and bismuthinite, in varying proportions. Roughly, the concentrates assay about 33 per cent. each of tin and wolfram. Thus, the last lot of concentrates from the mill went 32·5 per cent tin and 30·8

per cent. wolfram. The gangue is quartz, accompanied by pale fluorite, calcite, wollastonite, occasionally spodumene, a hydrated mica, and a little topaz. The adit has been continued 12 feet beyond the intersection of the lode. The country which it has traversed from start to finish is a belt of a peculiar massive-looking rock, breaking into large heads like an eruptive. There can be no doubt, however, that it is a metamorphic rock, and was originally limestone. Its essential components are lime minerals, wollastonite, vesuvianite, epidote, garnet. Numerous veins of a flesh-coloured mineral intersect it, which have a superficial resemblance to felspar or carbonate of manganese. From investigations, however, carried out by Mr. W. F. Petterd, it would appear that the mineral is wollastonite (silicate of lime).

The presence of a good deal of magnetite makes the rock dark. Green mica is abundant in it locally. Limestone crops out a little further north, in the banks of the Bismuth Creek, on T. J. Clerke's Section 2853-M, and I picked up stones of it on Hall's 237 acres towards the Iris River. On this section Mr. Selwyn Brown found the metamorphic rock again, but I was unable to verify this. The drive west on the lode continues in the metamorphic lime-rock for about 120 feet, and then passes into quartzite or crystalline Silurian sandstone. The junction of the two rocks in the drive is very difficult to fix accurately, as the metamorphic rock loses its magnetite, and becomes lighter in colour as well as less massive and softer. As the rock grows softer the lode improves. Owing to the heads in the rock its true bearing is not easy to determine, but it appeared to me that the general strike was east of north, and the underlay west of north, the quartzite underlying it. But I must confess there is some doubt about this, owing to the difficulty mentioned. At the east end of the drive the lode splits, and a rise is going up on one of the legs to the level above. A block of lode 350 feet long by 100 feet in height has therefore been made accessible by this drive, and Mr. Hitchcock, the mining manager, estimates on a conservative basis that it will yield 3000 tons of ore stuff. At the west end of the drive the lode has also split, and how it behaves further west can only be ascertained by continuing the drive in that direction. The backs westward, however, will diminish, as there is a depression in the ground. It is uncertain, too, whether the drive would pass under the basalt or into it, for there is some reason to fear that the volcanic rock is

deeper to the west. However, it is a work that will have to be done some time or other.

The same lode was formerly cut in No. 2 adit 100 feet above the No. 3, at a point 50 feet east of the rise at the end of No. 3 level, and was driven on 86 feet east and 227 feet west. The adit was begun in soft shale and clay, changing to quartzite a few yards in. This is just south of the boundary of the metamorphic lime-rock. At 80 feet west the stopes begin, and have been carried to surface, a height of 30 to 50 feet above the level, on a lode between 1 and 2 feet in width. Going west the lode passed into the wollastonite rock and improved, which is in accordance with what has been observed in the level below. The split in the lode corresponds with the one below.

The lode, although split going east, maintains the same width of gangue in the aggregate, and the drive should be continued east for exploratory purposes, even though there is an east blank in the level above. A fresh shoot of ore must in time be met with. A work of prime importance also is to extend the low adit so as to intersect the other lodes in the hill. The owners will then be in a first-class position for developing their property.

No. 5 and No. 5a. Lodes.—These are comparatively unimportant at present. No 5a has been driven on a few yards east and west. The lode is in quartzite country, and from 5 to 8 inches wide, decreasing going west. A few feet further south is No. 5 lode, containing a little wolfram, but only 4 inches in width. These two veins are only 12 feet apart, and will possibly be found to unite.

No. 4 Lode.—This has been intersected by No. 1 adit 230 feet above the No. 3 adit in 258 feet of driving, and driven upon 85 feet east and 63 feet west.

The lode above this level has been stoped to surface some 50 or 60 feet. As the surface of the ground falls both east and west, nothing much is left to work upon. In the west end the lode is split up with 5 to 7 inches in the middle of the drive and a small seam on each side. A little coarse wolfram is showing in the gangue. An intermediate level driven west comes in from the surface 35 feet above it, and the ground has been stoped out between the two. A block of lode 180 feet by 60 feet has been stoped away here. The mouth of the intermediate adit is 130 feet from the east boundary of section, or from the No. 1 adit to the section boundary 400 feet.

This No. 4 lode has ranged between 8 inches and 2 feet in width, and carried profitable quantities of tin ore, with wolfram and bismuthinite and carbonate of bismuth.

Further east near the creek, just east of the boundary-line of Section 2134, a short adit (creek drive) has been driven south-west for 100 feet, and then continued west for 21 feet on No. 4 lode or one of its forks. The lode gangue shows a little tin oxide, wolfram, molybdenite, bismuthinite. This drive is 87 feet below the other workings on No. 4 lode, and is a piece of work which ought to be continued, so as to come below the old stopes above the levels from No. 1 adit. Continuing the drive about 100 feet would bring it below ore worked out at surface above the entrance to the intermediate adit, and an additional 100 feet would lead to below the old stopes mentioned above.

No. 3 *Lode.*—This was intersected by No. 1 adit 87 feet south of No. 4 lode. It is, however, merely a lode-track, and no work has been done on it.

No. 2 *Lode.*—This has been cut by No. 1 adit 145 feet south of No. 4 lode, and has been driven upon 163 feet east and 100 feet west. This lode and No. 4 were the lodes that were worked in Mr. Mitchell's time. No. 2 has an average width of 15 inches. Westward it will go into shallow country. It had some good shoots of bismuth ore, with tin and wolfram.

No. 1 *Lode.*—The adit has been continued 168 feet further south, and beyond the south boundary of the section. No. 1 lode is a vein 140 feet south of No. 2, and parallel in direction to the others.

The present position as regards ore at this mine seems to be as follows:—Nearly 200 tons of ore stuff ready for crushing were stacked outside the adits at the time of my visit, and ground estimated to yield between 5000 and 6000 tons of ore stuff has been made accessible. At present the east end on No. 6 lode and the end in the creek drive on No. 4 are perhaps not payable to drive, but having been driven the lode above them is payable to stope away. The split in the east end of No. 6 forms two branches each 8 or 10 inches wide, and these are still separate in the rise 25 feet above the level.

In the level the north branch is being carried, and the south one left for a time. The two ends mentioned must be kept going, for two levels should always be advancing if the ore reserves are to be maintained. Once the dress-

ing-floors start there will be a constant drain on the stocks of ore in the mine, and progressive mine work will become more than ever a necessity. The floors were being remodelled at the time of my visit, and when ready they will comprise stone-breaker, rolls, jigs, 10 heads of stamps, 2 Wilfley tables, and 2 Frue vanners, and it is intended eventually to erect a magnetic separator at the mine.

The concentrates have an average value of about £100 per ton, which would give a value of £3 to each ton of crude ore. An improved water supply is being provided by the construction of a race 5¼ miles from the Weaning Paddock Creek. The lodes, though small, are persistent, and though several little displacements of them occur there is no serious faulting noticeable. There is very little doubt as to their continuance eastwards across the creek into the adjoining hill on Sections 1332 and 2134, and there is also no conceivable reason why they should not continue west across Section 1802 (with possible interruptions by basalt) into A. C. Hall's private land. For my own part I have not the slightest doubt but that they are there, and that some of this important group of veins extend right through from the Iris River on the west to beyond the All Nations sections on the east. In the latter direction they will eventually enter the granite-porphyry rock exposed at surface. The great piece of work which in the future lies before the mine-owners is to prove the lodes in the hill by continuing the low adit right across the lode zone.

Up the hill in basaltic alluvial clay are boulders of cemented conglomerate, containing layers or bands of coarse black tin oxide accompanied by some topaz. The conglomerate consists of quartzite pebbles bound together by a siliceous cement, and is apparently the debris of an old alluvial deposit which has covered these lodes at one time or other. The most probable explanation is that the deposit was covered by the Tertiary basalt, and has been subsequently broken up and released by its denudation.

From the point of view of the mineralogist and mining geologist the lode at the Shepherd and Murphy Mine possesses a certain degree of interest. The coarse crystallisation of the gangue minerals might easily suggest a comparison with the structure of pegmatitic veins, and this reference is strengthened by the occurrence of beryl and spodumene, but there is a singular absence of felspar and original mica.

The process which has been at work seems to have been that usually concerned in tin ore deposition, not dry sublimation, but deposition from gaseous solutions. Hence we see the usual association of tin ore with the fluorides (fluorspar and topaz) and hydrated mica, accompanied, however, by the lime products of the metamorphosed limestone through which the lode passes for a certain distance (wollastonite, calcite, vesuvianite, epidote, &c.). The hydrated mica in the lode, colourless to light-green in colour, requires analysis for exact identification of the species to which it belongs. There can be no doubt, however, that it is secondary. Such micas are known in some instances to have been derived from topaz and spodumene. The large flesh-coloured patches of the silicate of lime, wollastonite, in rosetted aggregates are striking characteristics of some portions of the lode.

A complete investigation of the complex mineral composition of these lodes may be recommended to students.

All Nations Wolfram Mine.

This property comprises four mineral sections, viz.: — 1332-M, 78 acres; 1019 and 949-M, each 78 acres, T. J. Clerke; and 2853-M, 80 acres, T. J. Clerke. These are situate about 12 miles south-west of Wilmot township, the main road from Wilmot towards the Caledonian Mine passing through the central (1332-M) section at an elevation of about 2000 feet above sea-level.

The main or No. 6 lode of the adjoining Shepherd and Murphy Mine has been worked to within 700 feet of the west boundary of Section 1332, and will apparently cross that boundary into the All Nations property at about 290 feet north of the south-west corner peg. The ground, covered with standing timber, then rises to the east to a height of about 600 feet, and no attempt has been made as yet to trace the lode through the section, but at 3 chains north of the south-east corner peg of Section 1332 the wolfram lode-line has been shown by a few trenches to cross the south-west portion of Section 1019-M and enter Section 949-M in a direction 10 degrees south of east. The last traverses in the east end of the Shepherd and Murphy No. 6 lode show a slight inclination to the south of east, and the probability is that this tin-wolfram-bismuth lode and the All Nations wolfram lode are either identical or connected. If so it is a remarkably persistent one, extending through nearly three sections, and possibly still further.

In Sections 1019 and 949 the lode has been opened upon by a deep open-cut along its course (now and then deep enough to necessitate covering with timber) for a length of 12½ chains, including a 30-feet tunnel at the western end of the workings. Along the open-cut line three shafts have been sunk, 20 feet, 53 feet, and 66 feet from surface respectively.

The lode varies from 6 inches to a foot, or occasionally even to 2 feet, in width, averaging perhaps 9 inches, and has been broken out nearly all along the open trench to a depth of 8 or 9 feet, in some places to 10 or 12 feet. It underlies steeply to the south, while the country dips to the north. It splits now and then, as at the lower shaft, but reunites. A branch has gone off north in the open-cut opposite the camp, and is not seen again, unless it has joined the main lode further east.

This lode is one of the most remarkable in the State, consisting of combed quartz crystals throughout, some of which are of great size and beauty. The crystals have been noticed as large as 14 inches in circumference. Some are pellucid; others are of the smoky variety. Vughs are frequent, and have been as much as 2 feet in width and 6 to 8 feet long. From one of these cavities as much as a ton of ore was obtained. The vughs are generally full of water, and the lode stuff is very hard between one vugh and another.

The lode mineral is the tungstate of iron, known by the name of wolfram. It occurs amorphous, or occasionally in imperfectly crystalline form, implanted on and between the quartz crystals of the lode, and can be very easily separated from the gangue.

The present owners have abstracted simply the smalls from the loose upper part of the lode by sluicing, leaving the harder lode-matter on the banks of the cutting for future treatment. The stones thrown out on the banks seem to be fairly-well charged with wolfram, and good dish prospects can be obtained everywhere from the smaller lode stuff associated with them.

A distinct feature of the ore in this lode is its purity. It is unaccompanied by pyrites or any deleterious mineral. Assays made by Messrs. W. & J. Lemprière, of Sydney, have shown the tungstic acid contents to go as high as 72·8 per cent.; and Mr. W. F. Ward, the Tasmanian Government Analyst, obtained by assay 72 per cent. The assays of bulk shipments, the original sale notes of which were shown to me, showed 66 per cent., 68½ per cent.,

70·5 per cent., 70·6 per cent., 71 per cent., and 71½ per cent.

As the English standard is 66 per cent., and Australian quotations are usually based on 70 per cent. ore, the grade of this ore is very satisfactory. As far as is known it exceeds that of any other wolfram ore shipped from Tasmania, and would (for 71 per cent.), at present ruling prices in Launceston, fetch here £160 per ton.

A few flakes of molybdenite occur in the lode occasionally, and there is a selvage on the hanging-wall from 1 to 3 inches wide, containing carbonate of bismuth and gold. A good dish prospect of gold may be obtained from this selvage anywhere. Samples which I took from it have been assayed by Mr. W. F. Ward, Government Analyst, with the following results: —

Bismuth	4·8 per cent.
Gold	11 dwts. per ton.
Silver	4 dwts. per ton.

The owners have worked in a desultory way, in winter, when a little water was available, for the last two and a half years, with two or three men, sending out enough ore to pay for working and prospecting expenses. To date, they have shipped to Sydney 8 tons 3 cwts. wolfram ore.

A peculiarity is that no tin ore occurs in this lode, while the same lode (if the two are identical) in the adjoining mine carries tin, wolfram, and bismuth.

The length of the lode-line and its persistence would of themselves indicate its continuance in depth, besides which No. 6 lode, its supposed prolongation in the Shepherd and Murphy ground, is being worked 500 feet lower than the All Nations outcrop The best part of this wolfram lode is comprised in a stretch of about 400 feet in length, in which shoots or patches of ore occur at intervals; in fact, nearly all the ore shipped has been won from this part of the lode.

Whether the shoots persist and widen out or not in depth will have to be ascertained by lower workings. Work was not proceeding while I was there, and I was unable to form a proper opinion as to the value of the lode at the lowest part of the workings, but the general appearance of the lode stuff thrown out from the trench was encouraging. I could see, however, that like all wolfram lodes, it is somewhat bunchy. Barren stretches may be expected, alternating with richer parts.

The highest backs available from the bottom of the western No. 1 shaft to the crown of the hill in advance of the present workings may be about 150 feet, and 40 feet additional may be secured by a crosscut to the shaft from the Narrawa Creek, a good deal of which would be an open drive. This would be the lowest depth at which the lode can be attacked by crosscutting on this side of the hill. This creek when I was there was sending down from one to two sluiceheads of water, and would probably supply sufficient water for dressing on the comparatively small scale required during five or six months in the year. By impounding it might be made to last longer.

The full development of the mine, however, must take place from the western side of the hill on Section 1332-M. The first step towards this is to trace the outcrop over the hill on that section by means of trenches, and to open an adit on its course eastwards. This will eventually come below the present workings in Section 949, only some 500 feet lower down. In the meantime it will be an exploratory adit, proving the lode, and if the latter answers expectations it can be easily worked and the ore stuff treated at works to be placed on the northern Section 2853-M lower down the Bismuth Creek.

An encouraging feature of the exploratory undertaking on Section 1332-M is that the lode in each of the bounding sections carries long and payable shoots of ore. If a fair amount of capital is introduced into this enterprise there is hardly scope for it in the present works on the eastern side only. It is apparent then that the natural and complete development of this property depends largely upon the discovery and behaviour of the lode on the western side of the hill in the unworked section.

On this side of the hill it must be remembered that the lode in all probability will be tin-wolfram, and the exploratory work will show whether the two outcrops belong to one and the same lode, or whether there are two lodes to be dealt with, one a pure wolfram lode and the other one carrying both metals.

Work could be continued at the same time on the lode on the eastern fall on a moderate scale, taking care to keep expenditure as low as possible. All this is on the understanding that the wolfram market remains favourable.

The price of this metal has doubled itself during the past year, and although the exact prices obtainable by producers is generally a matter for negotiation, the

demand resulting from new uses is so strong that it is expected rates will continue firm for a considerable time. The steel industry is absorbing all it can obtain, and latest advices are that the market is in an excited state. Constant enquiries are being received respecting wolfram mines and discoveries, so that it seems likely that producers will be sure of a good market for some time to come. The consumption of tungsten for high-speed tool steel is rapidly increasing, and the great toughness which it imparts to steel (often in conjunction with molybdenum and chromium) makes it sought after by the manufacturers of armour plates and projectiles. It is also increasingly used in the manufacture of motor and other car axles, springs, &c. The world's annual output of wolfram ore is about 3000 tons, of which Australia contributes a little more than half.

Up the hill southwards search has been made for the Shepherd and Murphy No. 4 lode, which is a parallel one, 600 feet south of No. 6. Small veins carrying wolfram and carbonate of bismuth have been found, but no lode corresponding with the one sought for. Stones of white pebbly sandstone with tin ore on the joint faces are scattered on the surface, which have possibly come from a belt of conglomerate on the hill crest. A long costeaning trench up the hill from here discloses loose stones of quartz and veinstuff carrying tin ore, wolfram, and carbonate of bismuth.

These trenches require to be cut rather deep to lay bare any solid lodes. On the south side of the crest the ground falls rapidly to the Iris section (H. Conder, 950-M), and the conglomerate zone gives way to quartz-porphyry, the marginal part of a granite mass. This quartz-porphyry occupies the southern half of Section 949-M, and contains great possibilities. Veins which intersect it carry tin ore and wolfram. Most of the ore occurs on the joint faces of the rock, but some of it appears to be disseminated promiscuously, and it is by no means impossible that prospecting will result in discovering some part in which the ore is sufficiently concentrated to pay for working. A good deal of the alluvial tin and wolfram ore found in the Iris workings has doubtless been derived from this quartz-porphyry, which also extends into that section. Some trenching was going on in the All Nations porphyry while I was at the mine, and some really good stones of ore were found. The nature of the rock warrants some expenditure in prospecting.

Down the Narrawa Creek, in Section 1019-M, alluvial tin ore has been won from time to time. A couple of tributors last winter took out 7 bags of high-grade ore. A wash from a few inches to 2 or 3 feet deep, and consisting of stones of quartzite, conglomerate, sandstone, and occasional lumps of vein-quartz, rests upon sandstone strata. Dishes of stuff washed showed about 2 ounces of tin ore per dish—black coarse tin with a few small topazes. The absence of wolfram indicates that the ore has not been derived from the veins on Section 949. I am rather inclined to think that it has come from some undiscovered source on the west side of the creek. As this is rather heavily timbered, it is not surprising that lodes have so far escaped discovery.

Lower down the creek the wash is deeper, where a party called the Lefroy Syndicate sluiced with a little water brought in from another small creek. Here the quartzite bed-rock is stained green with chlorite, and gives prospects of grey tin, quite different from the usual tin in the property, which is always black. By the side of the road, on Section 1332, there is a face of wash about 4 feet deep, which contains black and a little brown and resin tin ore. Prospects obtained were equal to 1½ or 2 ozs. per dish. A man turned to recently and got 3 bags of ore from it. No wolfram is found in this deposit either.

These alluvial deposits are deserving of mention, not because they invite the attention of any other than individual workers or working parties, but principally because they point to the existence close at hand of some lode or lodes not yet discovered.

All these sections have plenty of myrtle and gum timber suitable for mining purposes. The only deficiency is water, and this difficulty must be met in the way mentioned above.

As matters stand, wolfram is the mineral at present available, but tin ore evidently exists at more than one spot on the property, and prospecting may bring payable deposits of it to light.

The strata through which the lode passes in all three sections consist of the "pipe-stem" sandstone or quartzite described in the earlier part of this report. The southern Shepherd and Murphy lodes, if they continue so far, will also be found in the same rock in Section 949-M.

Iris Claim.

Section 950-M, 78 *acres*, *H. Conder.*—This is one of the sections formerly held by the Iris Tin Mining Company,

and was more recently acquired for a short time by the Tasmanian United Wolfram Company, Limited. In the northern part of the section a shallow alluvial deposit is being sluiced by tributors for a mixed tin and wolfram product, with a present value of about £100 per ton. The thickest wash seems to be about a foot, but as a rule it is not more than 3 or 4 inches, the overburden not carrying tin. Eight or 10 chains to the south of the workings basalt comes in, but at the workings and north of same the bed-rock is quartz-porphyry, and tin-bearing veins in this rock have apparently supplied the mineral which is being won. The porphyry ascends from the workings northwards to the centre of T. J. Clerke's Section 949-M, and the waste from this has probably contributed to the formation of the wash. The tin and wolfram ores are very little water-worn, and are frequently attached to small pieces of vein-quartz. Small topazes are very frequent.

The value of the ground is said to improve as the northern boundary is approached, but I believe on the whole it does not exceed 6 or 7 lbs. per cubic yard. From first to last 95 to 100 tons ore are estimated to have been won from here, but most of the deposit is now worked out, and there does not appear to be sufficient scope to induce the initiation of a water scheme, which is essential if anything more than desultory winter work is contemplated. There is a possibility of lodes being discovered in the course of stripping down to the bed-rock, but this is a rather slender chance. The high position of the section is against obtaining a water supply, and I fear the present method of intermittent work with idle spells in summer is what will have to be looked forward to unless a lode discovery is made.

Section 1037-M, 20 Acres, E. W. Clarke.

No work is being done on this section. The All Nations' wolfram lode must pass into it, but how it will behave when it enters the porphyry which is in the southern part of the section cannot be foretold. The section is one which, from its position, merits prospecting.

Packett's Section, 10 Acres, 970-93G.

This is a gold section, now vacant, situate south of one of the Narrawa reward sections. About nine years ago the disintegrated and cemented sandstone was dollied for gold. A trench was cut and a small shaft sunk at the head of a gully

going down to the Narrawa Creek. The sandstone carries small leaders of quartz with a little wolfram, and half-way down the shaft disseminated pyrites was met with carrying a little gold. The gold won is said to have been worth £3 12s. per oz. It is difficult to say what there really is in the formation, but as the slope to the Narrawa Creek is very steep, it would not be difficult to prove it by means of an adit. It is evidently connected with tin or wolfram veins, and it is not far from the junction with porphyry and granite in the eastern part of the section.

Section 1442-93G, 10 Acres.

This is east of the preceding. An Adit known as Spark's drive has been driven south-west into the hill on the south side of the track, first in sandstone and then in soft porphyry. This was ten years ago, and the tunnel is now too wet and muddy to enter, but outside the entrance are stones of coarse quartz or granite-porphyry containing wolfram and molybdenite. Quartz veins intersect the porphyry and carry coarse crystals of ore. A little pyrite is visible in the rock, which greatly resembles some of the tin-bearing rock on the Blue Tier, East Coast. The entrance of the tunnel is in Silurian sandstone, but further in the porphyry must have been struck; also an east and west lode.

About 10 chains further east, but whether on the same section or not I could not determine, are some workings recently operated by Mr. Black, but now abandoned.

Black's Workings.

South of the track and a little above it a cut about 20 feet long has been put into the hillside, showing a lode striking W. 10° N., and dipping towards the south. The quartz is 5 or 6 inches wide, and carries coarse patches and crystals of wolfram, with some bismuth carbonate and iron pyrites. Some of the quartz is smoky. The country-rock is a dark mica granite.

Still further east and on the track is Black's underlay shaft, sunk 35 feet in granite-porphyry, on what would seem to be a copper wolfram lode. Lode stone 8 to 10 inches wide, carrying iron and copper pyrites and black oxide of copper with wolfram is piled at mouth of shaft. Bearing of lode, N. 65° W. To the east of this the lode has been trenched upon, showing stone much oxidised at surface. There is nothing payable in this lode so far.

Nearly a hundred feet lower down the hill are two more shafts sunk by Mr. Black in granite-porphyry, 35 and 45 feet deep, and about 40 feet from each other. A large formation of mica and specular iron ore has been sunk on, being followed down on the underlay and then passed through into granite. In the west shaft hornstone was struck, indicating some contact. The formation strikes north-west. The oxidised lode-matter is traversed by narrow seams of wolfram between thin selvages of dark-green mica, and by veins of comby quartz containing a little wolfram. Native bismuth has been found, and a speck or two of free gold. Quartz veins in the granite-porphyry carry a little molybdenite.

Though nothing payable has been found, there would seem to be some possibilities here. To the south, over the range, is the old Dalcoath property, where a stanniferous stockwork exists, which was not payable in the old days, and which presents a problem somewhat resembling that offered by the Blue Tier tin deposits. This was not visited as there was no one who could show me any way of getting to it.

NARRAWA P.A., REWARD SECTION 35-93G, 20 ACRES.

This is the section north of Packett's. A descent is made 400 feet to the Narrawa Creek over Silurian sandstone country, and on the north side of the creek and about 30 feet above it a tunnel has been driven into the high hill range on the course of the lode for about 150 feet in a direction 25 degrees north of west. Two short crosscuts have been driven west, and a small cuddy also west.

The country-rock is a dark-grey quartzite, permeated with vein silica and impregnated with iron and arsenical pyrites, and a little copper pyrites carrying gold and silver. This impregnated zone forms the lode. I could not see that it had any defined boundaries. It rather appeared as if it might be an impregnated band in association with some fissure which has supplied the mineral. The degree of impregnation varies in different parts, being less in some parts than others, but the siliceous character of the formation is rather constant. A lot of red ferruginous mud is issuing from the tunnel, and much water is falling through its walls.

This and its abandonment for some time past make its examination difficult, and I found it useful to confirm my observations inside by looking over the tip. Among the stones I found some quartz carrying a little wolfram. It

is possible therefore that some such occurrence as this is the primary vein quartz which has started the silicification of the formation. Some selected pieces of the lode-formation which has been driven on picked up by me were assayed by Mr. W. F. Ward, Government Analyst, with the following results: —

Gold	4 dwts. per ton.
Silver	3 ozs. 1 dwt. per ton.
Copper	2·2 per cent.
Tin	Not detected.

It is evident that this lode shows abnormal features. It may belong to the group of cupriferous gold-quartz lodes, or it may be an extreme type of tungsten veins. No tourmaline is visible to the naked eye. A microscopical examination of the lode-material may reveal features which would lead to more definite conclusions, but I am inclined to think that the formation is an extreme member of the wolfram lodes so prevalent in this district. In driving this tunnel further the aim should be to locate some solid shoots of ore, and consequently frequent crosscutting will be necessary, for the formation is a wide one and the impregnation irregular. It is quite possible that payable shoots may be found, but close testing is absolutely necessary. The hill rises above the tunnel some 700 feet or more, and if anything payable is found, working it will be an easy matter.

Mr. Waller found some of the Bell Mount schistose porphyries on the Narrawa section. From this it is plain that the contact between the schist series and the Silurian sandstones is close at hand. But it will not be well to attach too great importance to this, as it is more probable that the granite contact was the dominating feature in the process of ore-deposition here, and it is extremely likely that the lode minerals in depth will be tin and wolfram.

Bell Mount Gold Diggings.

These are now virtually idle, the only worker being Mr. Alex. Campbell, the brother of the original discoverer, Malcolm Campbell. In 1892 and 1893 the wash was feverishly worked, but since then the field has been more or less dormant. It is impossible to get at the exact quantity of gold ore won. I am informed that the banks can only account for purchases of about 1000 ozs., but the most reliable estimates put the total at about 4000 ozs. Nuggets up to 22 ozs. have been found, and many weighing from 1

to 2 ozs. Bell, Poverty, Mosquito, and Basalt Creeks flow through the deposit of alluvial, which is from 18 inches to 18 or 20 feet in depth. The wash consists of sandstone and quartzite conglomerate and schist. The gold generally lies at the bottom of the wash, and below this is frequently a false bottom of black carbonaceous pug. The hill north of C. Adams' house is composed of a heavy quartzite wash with a bottom of pipeclay. Poverty Gully, as it was called, is between two mounds of made ground. There was only one payable claim in it, and the largest nugget got was 4 ozs. The stones in the valley evidently came from Bell Mount, but the wash of which the hills are composed has not been traced to its source. The bulk of the gold has been got from the larger gully to the west. In that creek (Bell Creek) the bed-rock is blue slate underlying the false bottom of dark pyritiferous pug. At the head of the old Amalgamated claim the rock is a soft sandstone, with a strike of N. 60° E., dipping to the south-east. In the upper west diggings there would seem to be a genuine lead, the only one on the field. The wash is composed of red sandstone conglomerate and pipe-stem (tubicolar) rock. It is significant, however, that the south end of the wash contains stones of basalt.

From what I could observe, I am inclined to refer the gold to quartz veins in the sandstones and conglomerates of the country, but too little is known of the country lying west of the Wilmot to say whether it has furnished most of the wash or not. Conglomerate and Silurian sandstone prevail in that country, but these rocks are also found all round. The matter is complicated by the occurrence of some Bell Mount schist in the wash. It is possible that there was here a large swamp or lake which was fed by streams coming from various directions. This supposition would solve the difficulties in an easy and natural way. The country to the north and west, preferably west, would be the source of the gold. That to the south is excluded, as it is tin-bearing country and would have shed tin and wolfram ore into the basin. The gold has not come far, and search may disclose the rich veins from which the gold won has been detached.

Great Caledonian Mine.

This is in Silurian sandstone and quartzite at the top of the Five-mile Rise. A shaft was sunk, levels driven in sandstone permeated with veins of cellular silica, a crushing or two taken out and treated in a fifteen-head battery.

It is difficult now to see what there was to work upon. The mine was soon abandoned, the battery removed, and everything at surface has since been destroyed by a fire. The store close by the track is the only existing relic. It is useful as a camp and shelter-place in this solitary spot.

The Devon Mine.

Section 1831-93M, 40 acres, leased by the Devon Mining Company, No Liability, and Section 4021-93M, 40 acres, in the name of J. C. Macmichael, but owned by the Company, are at the bottom of a deep gorge carved out by the Dove River. The mine is 2¼ miles south of the V.D.L. track, *i.e.*, as the crow flies, but the zig-zag bridle-path which leads down to it is nearly 3 miles in length. The Dove River flows through the sections, and the mine is on its precipitous banks, on Section 1831-93M. On the west bank is a galena lode carrying a variable width of ore, viz., from a few inches up to a foot.

The lode-channel also varies in width from a few inches to 3 feet on the outcrop, and is filled with quartz-porphyry and quartz, with occasional carbonate of iron. Pyrite is present in the gangue, so that the lode may be described as belonging to the pyrito-spathic group of lead veins, though siderite is only occasional. A little blende and chalcopyrite accompany the lead ore. Pyromorphite also occurs, and cerussite is plentiful in the upper part of the lode.

The bearing of the lode in the northern end of the workings is a degree east of north, and in the southern end 29 degrees west of south. The dip is very steep to the east.

The country-rock is a rather dense quartz-porphyry, composed of a ground mass of granular quartz, in which lie scattered larger crystals of quartz, orthoclase, felspar, and dark mica. The lode is in this rock, which passes into or joins granite in a southerly direction, while going north it abuts on quartzite or altered Silurian sediments. The hornstone which prevails at the contact makes it difficult to determine with the naked eye whether a given specimen belongs to the sedimentary or to the igneous series.

No tin or wolfram has been found associated with the galena, and there is nothing to show that the lode is in any way related to the stanniferous lode groups of the granite and porphyry of the Bell Mount district.

The output of the mine since 1899 has been 290 tons silver-lead ore. More than half this quantity assayed 5 dwts. 4 grs. gold per ton, 85½ ozs. silver per ton, and 55·9

per cent. lead. Lately 8½ tons were sold, assaying 2 dwts. per ton gold, 80 ozs. silver, and 60 per cent. lead, and realising, after deducting returning charges, £18 12s. per ton nett. The high gold contents are unusual for our galena ores. A selected sample of clean galena which I took was assayed by Mr. W. F. Ward, Government Analyst, and returned 80 per cent. lead, 3 dwts. 6 grs. gold, and 112 ozs. silver per ton. Work was suspended at the mine for nearly four years, but was resumed last November, since when 25 tons of galena have been raised.

The first adit (or No. 1 tunnel) was driven at about 20 feet above river-level in a westerly direction, and at about 70 feet in intersected the lode. In driving this adit a small formation with a westerly underlay was met with, but it does not seem to contain anything solid in the shape of a lode. Further in, about 10 feet east of the intersection of the lode, a small seam (6 inches) of quartz and siderite was passed through. Where intersected, the lode on footwall is very small. It has been driven upon 104 feet south and 24 feet north. In the south drive the lode-formation is a gossanous quartz from 6 to 10 inches in width. Very little galena (1 inch) is showing in the end. There is a rise up 40 feet from this level, and the lode on top carries 4 or 5 inches of ore going south and 3 inches going north in a gossanous formation. The north drive has been driven about 180 or 200 feet over the top of an ore-shoot which has been stoped up from the level below. It is now unsafe beyond a few yards from the flat sheet.

The main crosscut at this level has been continued west from the flat sheet for 25 feet, and would, it is estimated, have to be driven half a chain further to cut a parallel gossan formation seen at surface nearly 200 feet above river-level. The gossan outcrop is about 9 feet wide, interlaminated with porphyry, and is stated to carry 3 ounces of silver per ton. Its bearing is N. 9° E., and it is vertical or slightly dipping to the east.

No. 2 adit has been driven west from about 6 feet above the river at about 120 feet north of No. 1 approach, and just on the junction of the granite with porphyry. A small seam was cut in the approach, 3 inches wide, with a westerly dip. It will accordingly junction in depth with the main lode. At 70 feet in the lode was cut, but only 18 feet below the level above. The lode has been driven upon 70 feet north and 145 feet south. There is a fair quantity of pyrites in this part of the lode, and when the carbonate of iron comes in the galena seems to disappear.

Up to a foot of ore has been carried, but discontinuously. Beyond the stope a little cuddy has been driven to pick up the lode which was done a little further south. The lode crosses and recrosses the drive in the form of a mere track, but from 9 to 12 inches of ore are stated to be underfoot. In the south end it has pinched to a carbonate of iron track. In the level above this the ore extended about 60 feet further south, so it would appear that the shoots are pitching north. In the north drive a winze 17 feet from the flat sheet has been sunk 17 feet, and the lode in its north end was showing 8 inches wide when the water interfered with the work. Some clean seams of galena 3 inches wide are seen in the roof of this drive, but the end is barren, with bands of quartz and gossan continuing on the west wall.

A shaft has been sunk from surface 70 feet and 110 feet north of the winze, and a drive south started from the bottom, which will in time come 40 feet below the present bottom of the winze. This shaft had not been unwatered when I was at the mine, the water-level in it being within 30 feet of the top. I was told that the lode at bottom is good, and showing about 3 inches of ore. It has since been driven upon, and widened out to 8 inches of clean galena.

It will be gathered from this report that the Devon Mine has a small persistent lode carrying ore of a high grade. The cleanness of the ore has enabled work to be carried on without going to the expense so far of putting up concentrating plant, but of course the present stage of the work is a purely transitory one, as what the mine is going to be will depend upon exploration. The present shoot will have to be followed down still deeper, and as the shoots will probably all pitch north, driving south is indicated as soonest likely to meet with a new shoot. At the same time the adit crosscut should be continued, to cut the western lode.

An encouraging feature is the relative poorness of the gossan, which descends to the lowest level yet opened. It is likely that it has been depleted of its silver contents, and that these have been carried down to enrich the lode at a greater depth. At the mine I felt some anxiety as to how the lode would behave going south, as it seems as if it would shortly enter the granite which exists south of No. 1 adit, but from the plan it is evidently turning westwards, and thus following the apparent direction of the porphyry in which it lies. There is nothing to indicate that the lode will not descend to a great depth, or that the

ore in it is merely a superficial concentration; and more than one shoot of ore will probably be met with on its course. Its only drawback is its small size.

The cost of transport of the ore to the coast has diminished of late years, but is still a heavy tax on the mineral, being £3 19s. 6d. per ton to Devonport. As long as the outlet from the mine is *viâ* Wilmot the freight must be heavy on account of the packing cost to the top of the Dove River Gorge, but the rate could be considerably reduced by the improvement of the road between the Caledonian and Wilmot, and more Government money could very well be expended on this. Whether the mine continues work or not, the road will benefit the settlers along the route, so there ought to be no hesitation on the part of the authorities in opening up suitable means of communication.

Conclusion.

The whole district is one of high interest from a mineral point of view. The granite contacts have given rise to ore deposits of a varied character—gold, silver-lead, tin, wolfram, copper, which though mostly concentrated in small lodes are of good grade. The lodes have so far been explored for the most part only in a tentative way, and some of them have given results which may be described as promising. The district is geologically connected with the country further west, where the same tubicolar sandstone and conglomerates prevail. Some gold mining of a prospecting nature is being carried on in that country by Mr. Black near the Black Bluff. Mr. Black has also tried some ventures in the Bell Mount district, but more than individual attempts are necessary in a field of this nature, because as a rule the lodes are small and require a good deal of progressive work to be carried on ahead of ore-winning. For the present the tin and wolfram mining will be chiefly centred in the Shepherd and Murphy group of lodes and their extensions towards the All Nations, and silver-lead mining at the Devon. However, a galena vein is known to exist between the Bell Diggings and Bell Mount, and the same mineral may crop up elsewhere. The tin-bearing porphyries and granites extend eastwards on the slopes to the Forth River, and pass over to Mt. Claude. Gold is rather widely distributed throughout the district, but though a fair amount of alluvial gold has been won, no veins of any great importance have been found. The

numerous small veins have shed their gold during the process of denudation, and this has been carried into the alluvial deposits which have been worked by diggers.

I do not think that the chances are in favour of any very high development of any one mineral. The field is more likely to prove one of numerous small and rich lodes.

The progress made in settlement ought to help mining on, if care be taken to prevent the further alienation of land upon which outcrops of mineral are likely to exist. The increasing number of settlers may be expected to keep the routes open to and from the mines, and by spreading more people over the land will tend to facilitate new discoveries of mineral. This district is on the eastern edge of the practically unproved country between here and Waratah, and the few mining attempts which are now being made along this fringe merit all the fostering care and encouragement which the State can legitimately afford.

I beg to thank Messrs. W. E. Hitchcock, R. Mitchell, W. Tresize, C. Adam, and Mr. T. J. Clerke for kind aid and information, and Mr. Alex. Campbell for fossils from the Bell diggings. These fossils indicate a Silurian age for the sandstones and quartzites.

I append a note furnished by Mr. W. F. Petterd on his examination of the spodumene mineral from the Shepherd and Murphy lode.

Owing to want of time a map does not accompany this report, but this matters less, as a geological sketch map of the Bell Mount district is attached to Mr. G. A. Waller's report of the 3rd April, 1901. That report should be read in conjunction with the present one.

I have the honour to be,
Sir,
Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

W. H. WALLACE, Esq.,
Secretary for Mines, Hobart.

NOTE BY MR. W. F. PETTERD ON EXAMINATION OF ALTERED SPODUMENE FROM THE SHEPHERD AND MURPHY LODE.

In forceps infusible: gives after considerable heating strong reaction for Li, and the same in powder on platinum wire glows and gives yellow flame of Ca. On coal in powder becomes somewhat white, but does not fuse or intumesce.

With Na_2CO_3 no reaction. With borax bead slight trace of Fe. In matrass the mineral in powder gives a distinct reaction for H_2O, showing the substance is hydrated, which is often the case in altered compounds. Apparently portion of the Si and Al is replaced by Ca, which is not unusual.

On strongly heating in the open tube it loses colour and becomes greyish-white. The mineral has a somewhat lamellar structure, cleavage fairly perfect; surface of cleavage faces inclined to be pearly. Fracture uneven, tough, lustre decidedly oily. Colour greenish-grey to almost olive-green, translucent at edges. Crystals prismatic, short, irregular, striated, and flattened or compressed. System apparently monoclinic. The substance is more often than not massive, with enclosed or attached crystals of cassiterite. In hot HCl a slight disengagement of CO_2. Specific gravity, 3·4. Hardness, 4·5. Optically, refraction and double-refraction strong. In thin sections colourless and non-pleochroic.

With radium bromide (of 1,800,000 intensity), using a thin sheet of metallic aluminium as a filter to the natural glow of the preparation interposed between the assay and the cell containing the radium, a pale greenish light is observed, which is apparently characteristic; but after the mineral was strongly heated in the platinum forceps it did not respond to the emanations.

Some experiments were carried out with spodumene from other localities: —

No. 1. A large crystal 6 inches in length, colour greenish, white, and opaque, from Peru, Maine, U.S. America. This gave a distinct response to the radium rays. A chip was also used, and powdered mineral. The light was pale greenish. As before, a thin sheet of metallic aluminium was used as a filter.

No. 2. A somewhat large cleavage mass, slightly greener in colour than the preceding, also opaque, from Phillip

River, Western Australia. The radescence in this instance was not nearly so clear as that of No. 1, but still quite noticeable both in a fragment and in powder.

No. 3. Portion of a large crystal of the usual colouration, from Ulo, Sweden. No result from either thin chip or powder. Apparently not appreciably affected by the rays, though the specimen is quite characteristic in all respects, and the locality is well known to mineralogists.

No. 4. Transparent varieties of spodumene all gave a bright response to the rays. They were as follows:—Hiddenite, colour bright green, from Alexandra County, North Carolina, U.S.A. Triphane, colour clear yellow, from Minas Geres, Brazil. Kunzite, colour violet, strongly dichroic, from Pala, South California, U.S.A. These were all strongly radescent. The last becomes incandescent when heated in powder with the radium bromide.

REPORT ON GOLD AT PORT CYGNET AND WHEATLEY'S BAY, HUON RIVER.

Government Geologist's Office,
Launceston, 22nd June, 1907.

SIR,

PURSUANT to instructions received, I proceeded to the Huon River on the 5th April, to examine some ground taken up for gold-dredging at Wheatley's Bay and Lymington and gold-quartz mining works at Lovett.

Alluvial gold-seeking in this district was carried on thirty years ago, and about nine years ago some lode mining was started round Lovett. Whether visible gold had ever been detected in the stone has always been a debatable question, but the late Mr. J. Harcourt Smith claimed to have noticed fine specks in the stone at Mt. Mary, near Lovett, and his samples of the red ferruginous lode material at that mine when assayed by the Government Analyst confirmed his determination by returning 4 dwts. 2 grs. gold per ton. On my present visit to the same mine I saw similar specks in the same reddish contact rock, and a piece which came from this trench and showed numerous minute specks of what resembled gold scattered all over a joint face of the specimen, on being assayed by the Government Analyst, yielded 3 ozs. 4 dwts. gold per ton, and 2 dwts. 12 grs. silver per ton.

This gives a rather important clue as to where one may expect to find gold-bearing stone in the district, for this reddish stone is rather a feature of most of the reported occurrences. There is a N.E.-S.W. belt of alkaline porphyries (1) which are intrusive in the Permo-Carboniferous strata at Lovett and Lymington, and at intervals along the contact line is found a development of quartz, opaline silica and chalcedony, associated generally with an impregnation of the contact rock with pyrite which has decomposed to hematite, giving it a characteristic reddish colour. It is this reddish-coloured rock which shows visible gold.

(1) The term porphyry is here used in a field sense, and includes all the rock varities of alkali and nepheline syenites, tinguaites, essexites, sölvsbergites, nepheline porphyries, &c., which form the remarkable assemblage of alkaline rocks at Port Cygnet.

Any veins of quartz that there are in the district seem confined to the rocks in the neighbourhood of the contact, but quartz veins are not abundant, and need hardly be expected to be strongly developed, as the eruptive porphyry is not sufficiently siliceous for much surplus silica to be available for the formation of reefs. However, a certain amount of lode action has taken place at and near the contacts, and it would seem as if these contact formations are responsible for the gold which has been found in the alluvium of the creeks and flats.

The auriferous porphyry belt strikes right through the country to Little Oyster Cove and Peppermint Bay on the Channel. Gold-bearing creek sand occurs near the former. In it are small crystals of sphene, garnet, and zircon, besides a little flaky, water-worn gold. This sand is evidently the detritus of the Port Cygnet porphyry series.

The lode formations possess a purely scientific interest in being the youngest gold matrix in the island.

The gold quartz reefs of the north and east are all prior to the Permo-Carboniferous, while these southern occurrences are intrusive into the Permo-Carboniferous, and consequently younger.

The whole produce of the district, all in the form of alluvial gold, has been close upon 3000 ounces. Several years ago I took great pains to collect information bearing upon this point, and though exact figures are out of the question, the above estimate is probably very near the mark.

Petchey's Bay Gold Mining Syndicate.

This syndicate has applied for two dredging claims, one in Wheatley's and Petchey's Bays, and the other at the mouth of Forster's Rivulet and in Copper Alley at Lymington.

Between Lymington and Wheatley's Bay is a high hill-range which slopes steeply down to the Lymington Valley on the north, and to the Huon River on the south. The Permo-Carboniferous mudstones at sea-level are intruded into by the massive porphyry on both sides of the hill. This porphyry apparently rises into the heart of the hill, to a height of 700 feet above the river-level, and the gold deposited in the stone at or near its contact line with the sedimentary strata has been shed on the one side into the Lymington basin and on the other into the creek deposits and shore flats of the Huon River. One might expect therefore that the shore sands of the Huon would contain accumulations of gold. Such is in fact the case.

The beach in the little bay below Jno. Wheatley's 98 acres and H. Riseley's 24 acres is a flat floor of Permo-Carboniferous mudstone shelving off very gradually into the river. Dish prospects from the sand of this bay yield some very coarse gold. When I was there preparations were being made to bore with plant brought over from New Zealand, and test the bay thoroughly before going to the expense of a dredge. I was informed that as far as 500 or 600 feet from the shore the depth would not exceed 40 feet. North-east from this bay a valley opens into it covered with an alluvial deposit resting upon soft clayey porphyry about 40 feet above the river. A good many holes were sunk in this alluvial by former workers, from 6 or 7 feet to 24 feet. The wash as a rule is from 6 inches to 3 feet. The present syndicate have put down a dozen holes altogether. Some of these yielded only a few colours, others ¼-dwt. each. Riseley's Creek, which flows through this valley, has always been considered to return the most gold. Mr. Kube showed me 4 or 5 ounces of gold which mostly came from this creek. The gold is mostly honeycombed and heavy, and coarse, one flat piece weighing 1 dwt. 14 grs.

West of the above is another little bay, Kube's Bay, just below Mr. Kube's house, and this receives Kube's Creek, which has yielded gold all the way down from the hills, but not so much as Riseley's. However, it was thought that this bay would also give good results. The syndicate had bored 25 feet in the bay when I was there, but only got 5 colours from one bore. There would seem therefore to be little encouragement here. The shores here are also mudstone, and on the east side of the bay a vertical dyke of porphyry traverses the country N. 77° E., about 2 feet 9 inches wide.

A fair quantity of gold has probably at one time or another been shed into these bays, but it must be recollected that the Huon is a tidal river, and much of the metal is likely to have been carried off and distributed elsewhere. My visit left upon me the impression that there is hardly enough scope for a dredging enterprise. From what I know of this district, I shall be surprised if the boring tests disclose enough gold to cover the cost of a dredge, and even if they do, a dredge would make short work of the limited area within the bay.

There is evidently a junction of the porphyry with the mudstones just above the bank of Wheatley's Bay, and it is just possible that the flat was once covered with the

sedimentary rock, which has been removed together with the gold-bearing vein material at the contact. But the bulk of the gold has, I think, been derived from the contacts higher up the hill to the north-east.

I ascended this hill with Mr. P. Hardy. Gold can be traced up the valley, and just where the foot of the slope begins a hole has been sunk 20 feet in mixed porphyry and sandstone wash and clay, showing colours of gold. No quartz is visible in the wash, and the alluvium is not bottomed.

Close by is another deep hole sunk as far as water. A chain further is also a hole sunk over 20 feet, but not bottomed. The stuff thrown out contains reddish contact stone similar to that on the hillcrest. Ascending the hill about 300 feet above the river is fossiliferous sandstone. A saddle here is 700 feet above the river, and there is apparently a contact of the porphyry and shale. Going north from this, the hill-range is composed of pebbly grit and conglomerate, with seams of chalcedony and contact stone, hornstone, &c.

It is from this hill slope that it is reasonable to suppose that most of the gold at the foot of the hill has been derived. But I think the main source has been lower down the hill, because the sandstones at the summit are pebbly, and there would have been more quartz associated with the gold at the base if both gold and quartz pebbles had been mainly derived from the hillcrest. There is reason, however, to believe that the quantity shed has been moderate, and unfortunately the slow accumulation of alluvial gold during the past ages does not necessarily mean that a payable outcrop will be found at the top of the hill. In the course of time a payable spot may be struck, but at present there is no indication to guide prospectors beyond the general trend of the north and south contact line, as shown by the reddish chalcedonised stone.

This syndicate is also preparing to bore at the mouth of and along Forster's Rivulet, north of the Lymington jetty, as well as on the shores of Copper Alley, the bay south of the jetty. I have not been able to learn exactly how this bay derived its name, but heard locally that the prisoners in the old days found signs of copper. It is possible that green iron stains on the mudstone surfaces, such as are seen at Sturges Bay, Cradoc Hill, Peppermint Bay, and many other places in this area, have been mistaken for copper. This green-stained rock has been tested

in the Government laboratories, and the colour found due to ferrous oxide.

The old company at Lymington took out a considerable quantity of gold from the shallow alluvial on Mr. Coad's ground during operations extending over a couple of years. This Lymington Valley has been carved out right across the line of porphyry from west to east, and naturally carries the concentrations from the waste of the rocks which have disappeared. In 1884 or 1885 Mr. Lane sank in the bed of Forster's Rivulet above the bridge, and is said to have got half a grain of gold to the dish. The position of the mouth of this rivulet is highly favourable, assuming a fair quantity of gold to have been brought down by the creek, but from what I hear the gold in the valley and on the surrounding slopes is extremely patchy. While the creek and the bay are suitable localities for search, I am inclined to think success doubtful, at any rate, on a scale that would warrant placing a dredge in position. However, the tests that are to be made will soon settle the question. If this bay and the one on the Huon River can be shown to yield sufficiently to be payable, the united claims would then justify further expense. Just south of the jetty a dyke or exposure of porphyry crops out in blue shale, and is seen again on the north side of the jetty. North of the rivulet and along the shore of the Arm to nearly half-way to Lovett the rocks are mudstone shale and mudstone conglomerate, traversed by dykes of porphyry. Opposite Green Point porphyry comes in, and continues thence all the way to Lovett.

Lymington Mine.

In company with the Rev. Father O'Flynn and Mr. Davis, I visited the hill-saddle in the south-east corner of J. Direen's 22 acres, about a mile west of the Lymington township boundary, where on one side the hill descends steeply to the Huon, and on the other to the Lymington-road.

Here there is a cut into chalcedonised contact stone, but as this is on private property, a Lovett syndicate has gone a little south-east and put in a short adit, 60 feet, and also about 60 feet below the crown of the hill, which so far has only passed through softened and altered country rock of no value. A formation which is ahead of the adit face has been uncovered a little further east, but an inspection of this showed that it consists merely of

fossiliferous country carrying hydrated oxide of iron, and is not worth driving for.

In a westerly direction along the range towards Black Jack mudstones, shales, and quartzites continue to form the country rock, occasionally fossiliferous. At one spot the hardened mudstones are impregnated with iron pyrites. Still further west an excavation has been made in mudstone with a seam of limonite. The gossanous capping is rather inviting in appearance, but degenerates into a seam of limonite, which has the disadvantage of carrying no associated quartz nor pyrites.

All around is pebbly sandstone and conglomerate, the waste of which would give rise to a decided quartz wash. But quartz gold-bearing wash is rather exceptional here, and bearing this in mind, it is probable that the gold at the base has come from some part of the contact with shales and mudstones lower down the hill than these high workings. This view gains support from the general opinion in the district, that the best prospects are always found not on the top of this hill, but some distance down its sides.

The porphyry no doubt passes right under it, and there are lower points of contact from which most of the gold may have come.

Mount Mary Mine.

This is situate just south of the south boundary of the township of Lovett, in the north-east corner of W. Dance's 15-acre block. The country rock is pebbly mudstone and shale near its contact with alkali and nepheline syenite porphyry, which crosses the mountain and the Lovett valley to the Livingstone Hill in a north-easterly direction. At the contact itself a good deal of brecciated rock is seen, very likely due to the crushing force of the intrusion; and the familiar reddish contact stone carrying visible gold on the faces occurs at the outcrop.

Work was begun here in 1898, but after some time was abandoned, and only resumed at the beginning of last year, when a new shaft was started. In all, four shafts have been sunk. The first was only 14 feet in depth. At this time specimens of stone are reported to have given 4 dwts. and as much as 11 dwts gold per ton. The second shaft was sunk 60 feet, and the lode-channel intersected by a crosscut in 16 feet of driving to the north-west. Stone from this is reported as having assayed 2 dwts. 7 grs. gold per ton, but a sample from the whole width of

the lode (4 feet) taken by the late Mr. J. Harcourt Smith returned only traces of gold.

A third shaft was sunk 20 to 25 feet, and then abandoned. The fourth and present shaft has been sunk 73 feet. From the bottom a short crosscut has been driven south through the lode, which is here 3 feet wide, and has been driven upon east for 6 feet. In the lode-channel are up to 6 inches of green lode-stuff and silicified matter. A sampling which I took from the face was assayed by Mr. W. F. Ward, the Government Analyst, but only a trace of gold was detected. I was shown assay notes from Mr. Ward stating—2 dwts. 15 grs. gold per ton from green stuff; 8 grs. gold per ton from quartz; and 1 dwt. 7 grs. gold per ton from red stone. The 3-oz. red stone sent by me to Mr. Ward also came from the outcrop in a trench near by. As this trench has yielded several specimens showing visible gold, it might be as well to sink a little on the stone there. It is in fact the only formation in the district in which anything tangible in the way of gold is found, and I think a little money might be spent in proving it. From the manner, however, in which the gold occurs in this contact stone without any apparent channel, I am very much afraid that it will lead to the expenditure of money in search of something payable without resulting in anything really valuable. Still undoubtedly gold exists here, and there is an inducement to see how it goes down.

Livingstone Mine.

This is situate 2 miles north-east of Lovett on W. F. Rennahan's 173 acres, just north of the north boundary-line of John Thorp's 500 acres. A shaft has been sunk on the north-west fall of Livingstone Hill, which is a spur from Toby's Hill, at 600 feet above sea-level, on a quartz reef in nepheline syenite porphyry near the contact of the latter with fossiliferous Permo-Carboniferous strata. This shaft is not in a condition to enter at present, the collar having fallen in, but when I was here on a previous occasion it had been sunk upwards of 60 feet, following the parallel bands of quartz which, interlaminated with the porphyry, form the reef down to that depth on the underlay. This reef strikes a little north of east, apparently the same direction as the hill-spur, on the crest of which further east indications of the continuance of a line of quartz or reefing-stone are to be seen.

This shaft was sunk in 1898 on the strength of Victorian assays of specimens, which went 3 ozs. 23 grs. and

1 oz. 12 dwts. per ton. Subsequently an assay of 48 lbs. of stone gave 10 dwts. 13 grs. per ton. Later, a ton of stone was treated at Footscray, for 5 dwts. per ton. Then 6 tons of quartz were taken over, but no free gold was obtained, only 3 or 4 dwts. from the pyrites. Half a hundredweight which had remained over from the 1-ton lot was tried, and yielded only 13 grs. free gold per ton. These disappointing results led to the abandonment of work here. Some of the most likely-looking specimens taken by me from the tip were assayed by the Government Analyst, who could only detect a minute trace of gold.

The reef here is apparently a contact development, which may or may not be continuous. The likelihood is that the bands of quartz will be irregular along their course, though fairly constant enough in depth. Their behaviour in depth will most likely depend upon the accompanying line of the porphyry contact. The stone carries arsenopyrite, iron pyrites, copper pyrites, and a little blende and galena, an association of minerals which may be considered as a favourable indication for gold. It is in fact the most promising stone found in the entire district so far, and it is the only lode found entirely in porphyry. Evidently it has not carried much gold at the outcrop, or there would have been more of it found in the valley below. If it continues further east some more encouraging part may be found on its course. As matters stand at present, however, there is not much encouragement to go further with the work, in view of the poor results so far.

On the southern side of the ridge a tunnel was driven for about 400 feet, to intersect the reef at about 90 feet below the bottom of the shaft. The country through which it has been driven is the Permo-Carboniferous mudstone or sandstone traversed by dykes of porphyry. In driving, the direction of the adit was changed, and it now heads for the shaft. The reef line has not yet been intersected, but it cannot be far off. To settle the question as to whether the reef is likely to be permanent it would not be very expensive to continue the tunnel far enough for the purpose, and if the results then warrant further outlay, a new position should be selected for a working-shaft a little lower down the hill on the northern fall. It must be confessed, however, that looking at the results obtained so far from the shaft, any further work here would be quite speculative.

The Port Cygnet Porphyries.

These combine to make a rock group so unique in Tasmania, and not altogether matched anywhere else in the world, that a few general remarks thereon are called for.

Increasing attention is being paid to the Port Cygnet eruptive rocks in Europe. They have been under the notice of the most distinguished European petrologists, Professors Rosenbusch and Brögger, and an important treatise (in German) on some of them by Dr. F. P. Paul, of Sydney, has recently appeared under the title of "Some Foyaitic-Theralitic Rocks from Tasmania." (1)

As is now well known, the rocks belong to the alkaline division of eruptives. They contain an excess of the alkalies, soda and potash, and consequently sodic minerals are plentifully developed in them, *e.g.*, soda orthoclase, sodic augite and amphibole, nepheline, sodalite, häuyne, &c. It will therefore be readily understood how potent the waste from such rocks must be in forming a soil in the highest degree favourable for the fruit-culture for which the district is famous.

The petrographical classification of the rocks, as far as at present studied, may be stated as follows: —

1. *Family of the Alkali Syenites*—
   - (*a*) Plutonic representatives.
     - (1) Quartz augite syenite, or akerite, according to Prof. Brögger. This is the plutonic rock forming part of the promontory of Regatta Point and on the Back-road north-west of Lymington.
2. *Family of the Elaeolite Syenites*—
   - (*a*) Plutonic representatives.
     - (1) Elaeolite syenite. Part of the promontory of Regatta Point, and on Mount Mary.
     - (2) Jacupirangite. A dark facies development of the elaeolite syenite at Regatta Point.
   - (*b*) Complementary and dyke representatives.
     - (1) Nepheline syenite porphyry.
       - (*a*) The biscuit felspar rock on Mt. Livingstone and Mt. Mary.

(1) **Beiträge zur petrographischen Kenntniss einiger foyaitisch-theralithischen Gesteine aus Tasmanien, Dr. F. P. Paul. Wien, 1906.**

(*b*) The häuyne-bearing rock on Mt. Livingstone closely related to the preceding.

(2) Sölvsbergite porphyry. A greenish dyke south of Regatta Point.

(3) Mica-sölvsbergite. A dyke south of the preceding.

(4) Tinguaite. The dense green rock above Mt. Mary Mine.

(5) Tinguaite porphyry. The rock on the summit of Mt. Mary, with porphyritic crystals of sanidine felspar and garnet.

3. *Family of the Essexites*—

(*a*) Plutonic representatives.

(1) Essexite. Dark rock on the north side of Regatta Point.

4. *Family of the Theralites*—

(*a*) Plutonic representatives.

(1) Monchiquitic shonkinite. A dark rock forming part of Regatta Point. Described formerly as mica-nephelinite, with the habit of a monchiquite. Called monchiquitic nephelinite by Dr. Paul, who also refers to its shonkinitic affinities.

The above list is far from exhausting the rock varieties found at Port Cygnet, but at any rate it presents the principal types.

Pyrite is met with sparsely distributed in the igneous rock, quite apart from any vein formation, but no gold in the rock has ever been seen in the hundreds of specimens that have been examined. This metal would appear to be confined to marginal parts of the porphyry and the adjacent sedimentary strata, where silica and metallic sulphides have been introduced.

As regards the age of the porphyries, all that can be said at present is that they are intrusive in the Permo-Carboniferous beds. How much younger they are than these has not yet been demonstrated. They are found on the shores of D'Entrecasteaux Channel, and Mr. F. J. Ernst, in 1902, in making a traverse across the range, found that an outcrop of Mesozoic diabase exists between the channel and the Lovett occurrences, presumably cutting through the belt of porphyry. Of course, if this is a real

intersection, a step further is taken in the determination of its age, and the alkaline rocks must be referred to the interval between the Lower Permo-Carboniferous and the Upper Mesozoic. On this visit I made my way over the range east of Lovett, *viâ* Nicholls' Creek, and descended to Woodbridge on the shores of the channel, for the express purpose of studying the junctions throughout the traverse with reference to the age question. On the north side of the road along Nicholls' Creek, ¼-mile from the Arm and 80 feet above sea-level, a fine contact occurs in a little quarry showing nepheline syenite porphyry underlying the mudstone strata which are fairly horizontal. The latter are hardened near the contact, but I did not notice any occurrence of mineral or vein formation. About a mile further along the road diabase is exposed, and beyond this is mudstone. The actual contacts unfortunately are not shown, and it is not certain whether it is the porphyry or the mudstone which is cut through by the diabase. On the eastern side of the range diabase is seen near the summit, and is succeeded lower down by the Permo-Carboniferous strata into which it has penetrated, and quite at sea-level the intrusions of porphyry in the mudstones on the north point of Peppermint Bay are met with. At present, therefore, what we know is that the Permo-Carboniferous beds are pierced both by diabase and porphyry, but the evidence available as to the relative ages of the respective intrusions is not absolutely convincing, though there is a high probability in favour of the pre-diabasic age of the porphyry. On the other hand, all the other occurrences of alkaline rocks in Tasmania are of Tertiary age.

Conclusion.

The general conclusions which I draw from this examination of the Port Cygnet district are very much the same as those embodied in my former report on this field. These are, briefly, that gold will not be found disseminated promiscuously through the porphyry, but is confined to the silicified and brecciated stone at the junction of the eruptive and sedimentary rock, sometimes in one, sometimes in the other, or in quartz veins connected with these contacts. The deposition of gold and mineral sulphides along these lines has not been great, and is irregular and patchy, and though prospecting has been carried on at several points, nothing payable has been struck so

far. The gold won from the creeks and valley flats has been derived from the slow waste of the contact lines, and it is only along these lines that prospecting has any chance. Unfortunately, however, there is not much encouragement for spending money on the lode formations in the hope of payable results. On the whole I do not think that enough gold exists in the bay sands to warrant the construction and installation of dredging-plant. Nevertheless, the Port Cygnet goldfield is so unique that I am not without hope that some day or other, by prospecting or by accident, some part of the lode-line of sufficiently high grade to work may be met with.

I have the honour to be,
Sir,
Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

W. H. WALLACE, Esq.,
Secretary for Mines, Hobart.

THE MANGANA GOLDFIELD.

[Four Plans, Two Photos.]

I.—Introduction.

Mangana is a small township, 5 miles from Fingal by road, situated on an alluvial flat which forms the floor of a valley bounded by hill spurs descending from Ben Lomond and Tower Hill. The hills rise steeply from the plain, and consequently give the place a picturesque aspect. The native name Mangana had some connection with the river, for *Mangana Lienta* signified the South Esk River, distant 4 miles to the south.* A back road over the hills runs north to the township of Mathinna, and a tourist track has recently been made to the shelter-hut near the summit of Ben Lomond, where Col. Legge has established a thermometer station. The grade of the track up that mountain is comparatively easy, and Mangana forms an excellent base for expeditions. Mountaineers cannot do better than place themselves in the hands of Mr. Donald McLeod, of the Alpine Hotel, Mangana, who will make all arrangements for the ascent.

The goldfield is situate in the area of slate and sandstone strata of Lower Silurian (Ordovician) age, which forms a large auriferous belt of country running through to the northern coast of the island, and embracing the goldmining districts of Scamander, Mathinna, Mt. Victoria, Warrentinna, and Lyndhurst. The exact prolongation of the strike of the Mangana strata would cut the River Tyne near its confluence with the South Esk, and not the Mathinna field, as frequently asserted. The line of the Mathinna strata extended south-east emerges on S. R. J. N. Talbot's 500 acres, in the bend of the South Esk River, near Fingal.

II.—Previous Literature.

The following reports have been published by the Government of Tasmania:--

1. Gold at Mangana, by Chas. Gould, Government Geologist, 31st July, 1869 (Legislative Council Paper No. 20).

* Fenton's "History of Tasmania," 1884, p. 443. The word "Munnna," however, denoted wattle-tree gum; and "Mungunna" was the word for fish.

2. On some portions of the Mangana Goldfield, by Alex. Montgomery, M.A., Government Geologist, 25th September, 1894 (Report of the Secretary for Mines, 1894-5).
3. On the strata in the shaft of the New Sovereign Mine, Mangana, by W. H. Twelvetrees, Government Geologist, 6th November, 1899.

Mr. Gould describes four reefs discovered by Mr. J. C. Goodall along the summit and flanks of the ridge dividing the tributaries of Major's Gully, which are charted as Golden and Fern Tree Gullies. He is of opinion that if the shafts which were then being sunk prove the reefs to hold as good in depth as they appeared to be on the surface, there is sufficient stone in sight for several years' crushing.

Mr. Montgomery reports on the Reunion, Cardinal, Buckland, and Alpine mines; and on Specimen Hill workings.

The report on the New Sovereign Mine is an examination of the shaft workings of the mine now owned by the Mangana (Tasmania) Gold Reefs Company, Limited, as far down as 280 feet, the then depth of the shaft.

III. - Physiography.

Mangana was originally called the Nook, and the little valley forms a veritable nook at the base of the high hill ranges which rise abruptly from its borders. These hills are lofty spurs, which divide mountain-stream channels or ravines known as Richardson's Creek, Calder's Gully, Major's Gully (resulting from the confluence of Fern Tree and Golden Gullies), Grant's Creek, Sharkey's Gully, Sailor's Gully, &c. The spurs rise immediately round Mangana to a height of 700 or 800 feet, and towards the north they continue rising, and constitute shoulders or buttresses of Tower Hill, the summit of which is nearly 6 miles northwest of the township, and 3900 feet above sea-level. About 1000 feet above and north of Mangana is a small farming settlement called the Towers. Richardson's Creek receives the waters of the various creeks mentioned above, and itself flows into the Tower Rivulet (locally known as Ben Lomond Creek), a tributary of the South Esk River, 3 miles west of Fingal. The latter river follows a tortuous course of nearly 100 miles, till it empties into the Tamar, at Launceston. In the lower part of Major's Gully the Creek flows under the surface of the shingle. The narrowness of these gullies and the steepness of their sides point

to the excavating work of the streamlets having been performed in comparatively recent times. When they cross the course of reefs, they do good service to the prospectors by exposing these, and enabling them to be worked by adit levels. In the northern part of the field the direction of the ravines is more or less north and south, coinciding approximately with the strike of the reef-lines, and these consequently contribute to the formation of spurs which resist denudation. Hence the most accessible parts of reefs are frequently at high elevations.

IV.—Geology.

The strata of the field consist of slate and sandstone, considered to belong to the Ordovician (Lower Silurian) system. No fossils have been found confirming this reference, which is made only on stratigraphical and analogical grounds. The alternations of sandstone and slate show the cleavage partings in the rock to be mostly coincident with the lines of bedding. The sandstone is generally crystalline, and the whole series has been subjected to the processes of compression and cleavage, which in Tasmania are believed to have operated strongly at the close of the Silurian. It is made up of finely-divided detritus, derived from the wearing down of quartz felspar (granite) rock masses, which have now entirely disappeared from the locality, if indeed they ever existed in this part of the island.

The general strike of the beds is N. 25° W., and east of the township their general dip (underlay) is to the north-east, while west of Mangana, on the hills above Calder's and Major's Gullies, and on the Black Boy spur in the township itself, the strata dip to the south-west.

An anticlinal arch appears to have existed over the present flat of the Fingal (Grant's Rivulet) valley in the north angle of the township, and the reef-lines throughout the district are probably related to the processes of compression and strain, which may be considered responsible for the formation of this arch.

A strong unconformity exists between the slates and the beds of grit, conglomerate, and mudstone, which overlay them, and which pertain to the Permo-Carboniferous system. On the hills north of the township, at a height of between 950 and 1000 feet above the level of the plain, a layer of this conglomerate, 30 or 40 feet thick, covers the Ordovician strata. The pebbles are quartz, and sometimes slate, embedded in a sandstone matrix. Small cliffs of this

conglomerate are exposed on the hill ridge between Calder's and Fern Tree Gullies, about 5 chains south of W. Gellibrand's 157 acres, at 1000 feet above Mangana. On the Alpine Hill, also between Richardson's Creek and Calder's Gully, stones of this conglomerate are strewn on the surface about 100 yards north of the Alpine outcrop workings. Boulders of reddish sand and grit enclose pebbles of sandstone, slate, and quartz. A little further south, between the Alpine hut and the Cardinal shafts, a few feet of Permo-Carboniferous sandstone appear to overlie the older slate. East of Mangana, at the head of Sharkey's Gully, near Talbot's gate on the divide, and at an elevation of between 600 and 700 feet above Mangana, the hill capping is composed of Permo-Carboniferous mudstone. The residue of this covering is nowhere thick, and it is easy to see that the slate throughout the district has nowhere suffered any great denudation since it was first buried below the Permo-Carboniferous sediments. From this fact it may be inferred that no great waste of gold quartz reefs can have taken place, and, consequently, that the amount of gold present in the alluvial does not afford a fair criterion of the value of the reefs. Fossiliferous mudstones occur high up the shoulder of Tower Hill, as well as on the Fingal township. The difference of level between the two exposures points to considerable faulting somewhere, but it would require a very close examination of the geology of the locality to locate the line of displacement. The plain through which the South Esk River flows consists partly of alluvial matter, which was deposited in Tertiary times, and this gravel has been shown by borings to go down below the level of the present river bed. This alluvial becomes shallower towards Mangana, and at the township it is not more than 30 or 40 feet in depth. It gradually gives place to the modern wash of the mountain creeks in ascending the gullies. In Tertiary times the deposit probably extended higher up the low hill on Robertson's Freehold, to the west of the township, but some denudation must have taken place during subsequent elevation of the land. These Tertiary deposits in the South Esk basin extended as far north from Fingal as the present site of Mathinna.

Igneous rocks appear at a few places on the Mangana field, but, genetically, are quite unrelated to the gold quartz reefs. The summit of Tower Hill is formed of diabase (greenstone or trap), the plagioclase-augite rock which everywhere is found intrusive in the coal measure sedimentaries (both upper and lower, *i.e.*, Permo-Carbon-

iferous and Mesozoic) as sheets, pipes, dykes, or in some other form. On the flanks of the hill below the summit is a fringe of Permo-Carboniferous strata, but whether these pass underneath the diabase or whether the latter cuts them off is as yet an open question.

On the track to the Alpine Mine, about 400 feet up the hill, is a small patch of diabase, which has come up through the slate at this spot. The igneous rock is here greatly decomposed, and does not appear to be exposed for a width of more than 20 feet.

A further exposure of the same rock is on the 20-acre block of Robertson's Freehold, west of Mangana. It occupies the western part of that block and the southern angle of the adjoining 31 acres, and extends westward to the mining sections, ¼-mile distant, forming a considerable mass.

A similar rock forms the top of Ben Lomond, the Fingal Tier ("Bare Rock"), and other heights in the neighbourhood. Microscopical examination shows an absence of the type of structure which would denote a deep-seated (plutonic) rock, as well as of that which characterises effusive (volcanic) rocks. Their micro-architecture (diabase type) conforms with that of rock masses which exist as laccolites or intrusive sheets.

The age of these rocks is not older than late Mesozoic, as it is clear that they have intruded into our Upper Mesozoic shales and sandstone, but any closer determination than this seems impossible for the present.

The quartz reefs at Mangana are for the most part enclosed in the Ordovician slate and sandstone strata. Only at one point did I see what appears to be an upward extension of the reefs into the overlying Permo-Carboniferous, viz., on the Buckland Spur, where an exposure in a trench shows a somewhat feeble continuation of the quartz into the flat-lying younger sandstone. However, more extended examination is necessary before what would appear to involve a younger age for such a reef can be used decisively for building any theory upon it. Quartz veins have been observed in the coal-measure sandstone elsewhere (on Ben Lomond and near Buckland, as well as at Port Cygnet). But the Mangana reefs typically are confined to the older strata, and their occurrence is probably closely connected with the tectonic processes of folding, which may be conceived as having released and enclosed the siliceous residue of the granite magma. That reef-formation is in some way related to the bending of the beds may be inferred from the change in dip of

reefs when found east or west of the township. All the reefs east of the Fingal Valley axis have an easterly dip, while those on the Buckland or Alpine Spur dip to the west. It is highly possible that a reef or reefs may exist along the axial line of folding below the plain of the Fingal Valley.

V.—Economic Geology.

The gold-bearing quartz assumes the form of veins and reefs, for the most part running in northerly and north-westerly directions, generally conforming with the enclosing strata in strike and dip, and varying in width from mere threads to as much as 25 feet in width. Some of these reefs are barren, or at all events not payable. The quartz generally is white and glassy, and not as a rule charged very heavily with pyrites. Where pyrites is present, the dominant species is iron pyrites. Arsenopyrite is subordinate. Copper pyrites, galena, and blende occur sporadically, and are good indicators of the proximity of gold. The rich stone found near the surface in this district has probably been indebted to processes of solution and re-precipitation for its wonderful gold contents (Golden Entrance quartz having yielded 39½ ozs. per ton). Some of the reef-channels have been the seat of subsequent movements, which have torn and forced apart both quartz and the slate laminæ, widening the reef and giving it a mottled appearance, which, if accompanied by pyrites, is a favourable augury for gold contents. Oxidised parallel partings in the stone are welcomed by the miner as very apt to carry gold. The reefs in the hills to the east of the township are in directions which cause them to cross the gullies, and the latter, notably Sharkey's and Sailor's, must have removed considerable quantities of quartz while carving out their channels. On the other hand, on Major's and the Alpine Hills, the ravines mainly run parallel with the reefs, which consequently have only been subject to the denudation going on upon the hill spurs.

It is probable that much of the alluvial gold which has come into Mangana from the north was not shed from the Alpine and Major Hill reefs, for these reefs are not cut by the main ravines. The local opinion is that the Permo-Carboniferous conglomerate or cement is responsible for a good deal of it.

Gold has been found both in the cementing sand of this conglomerate and in quartz contained therein, and the iron oxide with which much of the alluvial gold coming from the northern part of the field is coated confirms

the idea that gold is derived from the ferruginous cement. This is the view held locally, and much can be adduced in its support. There is not the slightest reason why alluvial and specimen gold should not exist in the Permo-Carboniferous conglomerate. During the time that it was being laid down the gold-bearing reefs were exposed, and must have shed their waste much as it is being shed to-day. It must be remembered, however, that these conglomerates were probably extensive sea beaches, and concentrations of gold in them were likely to be few and far between. Still, some auriferous runs may be found in them, and prospecting in this formation may be encouraged.

VI.—History.

The first discovery of payable gold in Tasmania was made at Mangana, in February, 1852, about 150 yards below the present bridge. The Launceston *Examiner*, of 18th February, 1852, stated:—

"Letters have been received in town announcing the discovery of gold within 4 miles of Fingal, by James Grant, Esq., of Tullochgorum. The following is an extract from a letter from a gentleman in the neighbourhood, dated the 16th instant:—'Gold has been found within 4 miles of Fingal. I saw it myself. The largest piece was the size of a duck shot, the other pieces smaller.'"

Another paragraph appeared in the Launceston *Examiner*, of the 12th May, 1852:—

"James Grant, Esq., of Tullochgorum, has claimed on behalf of Keeling Richardson the reward of £500 offered by the Launceston committee in September last for the discovery of a goldfield in the northern side of the island. He states in the memorandum which he has submitted to the committee that, of the quantity forwarded, 1 oz. 38 grs. were procured by Keeling Richardson from about five bushels of soil, with the assistance of one man at the cradle, in eight hours.

"One of the pieces procured (a nugget) weighed 139 grs. The remainder consisted of smaller pieces."

Mr. James Fenton, in his "History of Tasmania" (Hobart, 1884), writes on the subject as follows:

"The first payable gold in Van Diemen's Land was found at the Nook, 4 miles from Fingal, in February, 1852. It attracted about 200 persons for a short time. They thoroughly prospected the country round, and those who steadily persevered made it pay. Very minute

particles of gold-dust were procured along the Tower Hill Creek and on the hillsides, where beautiful specimens of crystallised quartz abounded, but in a few weeks the place was left in the hands of a few of the original claimants, who made a fair profit on their industry for a considerable time."

Mr. J. C. Goodall, the pioneer who has done so much in the way of prospecting and mining at Mangana for the last 42 years, has furnished me with the following statement, which gives some interesting historical information. He says:—

"I visited Mangana in 1866, and found the Union Company's quartz mine at work, this being the first gold-bearing reef discovered in the colony. The developments were being carried on by adits, and a 10-head battery was crushing the stone. On Grant's Creek the Fingal Company was shaft-sinking and quartz-crushing with a 10-head battery. The yield varied from 5 dwts. to nearly 1 oz. per ton, obtained by both companies. The Union was by far the more promising of the two mines. Its reef was from 4 to 12 feet wide, with some bulges of stone up to 20 feet, but the widest parts were poor, averaging from 3 to 7 dwts. per ton of fairly rough gold. An open-cut was put in half-way up the hill on a discovery of rich stone with very rough gold, so rich that I saw the manager crush over 50 lbs. weight in the mortar and it yielded over 4 ozs. gold. Several stones crushed by hand gave 1 dwt. of gold to the pound. In working this discovery barren reef matter and mullock were crushed with the richer stone, and the battery average was brought down to less than 10 dwts. per ton. Some time after this the Union Company closed down, and remained idle for years.

"The Fingal Company's mine was on a short shoot of stone worked to 170 feet in depth, and, on the whole, was not payable. The mine is situate on private property, and has been idle the last 30 years. I paid special attention to the country at the head of Fern Tree and Golden Gullies to ascertain whence the alluvial gold of Major's Gully was derived. On 10th January, 1869, I discovered the Tower Hill reef, showing good payable gold quartz, but to my astonishment I found it was on privately-owned land, 157 acres, belonging to the late William Gellibrand. Eventually a company was formed in Hobart, and I put up a 10-head battery. We had several crushings of good 2-oz. stone, but two or three poor crushings frightened

the shareholders and directors, and the mine was closed down. Only surface-scratching was afterwards done by co-operative parties, until the machinery was destroyed by fire. In 1877 I discovered the Alpine reef on Crown land, and secured the lease of Buckland's Freehold, on which estate I also discovered the Buckland No. 1 reef, which produced over 1000 ozs. of gold from 1319 tons quartz. The reef was from 18 inches wide at surface to 3 feet wide at the bottom of the winze, 170 feet. The Alpine and Buckland estates were floated into three separate companies in Hobart. The Alpine reef was not proved to any great depth (about 150 feet), and some excellent crushings were obtained. A few poor crushings caused work to be abandoned. Later I took up the forfeited Union leases, and discovered the Sovereign reef, on the top of the hill, which I worked for about a year, and then sold to a London company (Mangana Gold Reefs, Limited). I have prospected lately on the Buckland's Freehold, a 30 years' lease being held by Launceston investors, who also intend to start work on the Buckland No. 1 reef by putting in an adit 100 feet below the old workings. The last crushing from the bottom of the winze was 80 tons, yielding 152 ozs. gold, some 21 years ago."

Mr. James Fenton writes: *

"The first quartz-crushing company (the Fingal) commenced operations in April, 1859. Its machinery was imperfect. It obtained about 250 ozs. of gold during the first four months. The stone crushed yielded 8 or 10 dwts."

Looking at Mangana as it is at present, with its numerous reefs exposed and mines idle and giving employment to not more than half a dozen men, it is difficult to realise that this was the first goldfield in the Colony. Although Mr. Fenton gives the priority to the Fingal Company,† I am informed that the Midland Company was the first quartz-mining company, which afterwards successively became the Union, the Reunion, the Sovereign, the New Sovereign, the Mangana (Gold) Reefs, Limited, all working on the reef in the Union or Sovereign Hill. Some of the richest quartz known in Tasmania came from this reef. All the gullies were scoured for gold in the old times, and responded excellently to the search. Major's

* "History of Tasmania," Hobart, 1884, p. 308.

† He probably means the company at the Fingal diggings, as the Mangana field was then called. This company was then known as the Midland.

Gully has the reputation of having been the best, and gave employment to 400 men in its palmy days. The largest nugget found on the field was obtained from Fern Tree Gully, which feeds Major's. It is variously reported as 7 ozs. and 11 ozs. in weight. Sharkey's Gully, opposite the hotel, also used to yield rich specimen quartz. The Golden Entrance Mine, on the divide between Sharkey's and Sailor's Gullies, has yielded about £10,000 of gold-bearing quartz, but it is now struggling along on tribute.

It is difficult to avoid recognising that in the old days a mistake was made in selling the mineral land round the township The consequence is that many reefs are now on private property, and the mining population of Mangana, instead of prospecting and developing the lodes in the surrounding hills, leave their homes during the week and occupy themselves with tin-mining on Ben Lomond.

VII.— Mining.

(*a*) *Mangana Gold Reefs Mine.*

Mangana (Tas.) Gold Reefs, Limited.—Sections 1259-93G, 30 acres; Section 557-G, 10 acres; and 318-93G, 5 acres, battery site.

A gold quartz reef of variable width, but attaining in places a maximum width of 25 feet, runs right through the hill on Section 1259 from Sailor's Gully to Sharkey's Gully, and various outcrops have been also found on the southern section (557), one of which must be the southern continuation of the reef. It seems to be almost certain that the reef is traceable at surface for at least half a mile, and this is a strong indication of its persistence to a depth greater than that of the present workings.

The average bearing of the reef is N. 42° W., and the dip to the north-east. There is very little difference between the strike of the enclosing slate and of the reef itself; sometimes the bearing of both is identical; in dip, also, the reef follows the country.

Apart from the light decolourised slate in the superficial zone, the workings show mostly dark slate down to 200 feet below the gully, purple slate from 200 to 600 feet, and a compact grey slate between 600 and 800 feet. Where the reef is wide the quartz is mixed considerably with slate, giving the stone a mottled aspect. The width varies from under a foot to as much as 25 feet, of which, in the upper parts of the mine, from 4 to 6 feet of solid quartz is met with, the remainder being mixed quartz

and slate, occurring irregularly in the reef-channel. The slicken-sided lode slate points to reef movements subsequent to the deposition of the original vein quartz.

The reef minerals are pyrite, arsenopyrite, and a little galena and copper pyrites. The reef belongs to Beck's group of pyritic gold quartz reefs, in which the dominant sulphide is iron pyrites.

The former companies which worked this property (Union, Reunion, Sovereign) operated on the reef in the hill on the north side of Sailor's Gully, while the present company has explored it from a main shaft sunk to 800 feet below the gully floor. I am informed by Mr. J. C. Goodall that the first gold found in quartz at Mangana was obtained from this reef (Union). There is no return available of the total gold won, but it is certain that the amount was by no means inconsiderable, and some rich shoots were met with in the upper workings by the early companies.

Upper Adits in Hill.—As said above, the work done prior to the present company consisted of adits driven north-west into the hill on the course of the reef. These are at different levels from Sailor's Gully to within 60 feet of the apex of the Sovereign Hill, the highest one communicating with the summit by means of the Sovereign shaft. Altogether, these upper works comprise 2200 feet of driving, 300 feet of crosscutting, and 750 feet of sinking and rising, besides an unascertainable amount of stoping.

The main adit (No. 4) has been driven into the hill from near the new shaft at 25 feet below the collar of the latter, and has been extended north-west 550 feet. No. 3, 112 feet above No. 4, has been driven 720 feet; No. 2, 94 feet above No. 3, has been driven 625 feet; and No. 1, 137 feet above No. 2, has been driven 275 feet.

All these have been driven on the reef, which in places is from 10 to 20 feet wide. Its character is extremely irregular, often soft and mullocky, and again widening into large bodies of hard stone. The quartz is white and but little mineralised, and very largely dissected by bands of slate.

No. 4 Adit.—At a little distance in this adit the reef-channel is 5 to 6 feet wide, but soft and mullocky, developing into a mixture of quartz and slate, the quartz often showing in curved bands. A little north of the main shaft the reef has been stoped up to surface and down to No. 1 level in the new mine. It is reported to have carried very good gold at times.

At 190 feet in a crosscut has been driven out south-west for 100 feet without intersecting anything of importance. It passes through regularly laminated slate country, dipping north-east. At one point a small vein of valueless quartz was cut. The crosscut was of distinct use as establishing the non-existence of parallel reefs outside the main channel. Between this and the 180-feet air-shaft (Union shaft) the reef has been stoped to surface on 2 feet of quartz for 120 feet beyond the crosscut in the Union

Mangana Reefs Shaft.

shaft, but beyond this there is not much quartz in this level. The face is 240 feet beyond the shaft, and this part of the adit is in soft, dark lode slate, which has been mostly worked with the pick. Short crosscuts would have to be put out each way behind the end to prove the width of the reef. The face carries lumpy white quartz for a width of 5 feet 8 inches. This stone, although barren, has a more favourable look than anywhere in this level north of the Union shaft. Further 400 feet of driving would bring this level under the Sovereign shaft, and in doing this it would pass below the large block of ground stoped

the level above and the surface, and also meet shoots pitching south.

f the entrance to this adit a wide spur of quartz off to the east. Its full width has not been proved, but about 20 feet of it have been taken crushed. The stone for a width of 3 feet is to have returned 1 oz. gold per ton. What is left at about 5 dwts. The hard bands of clean stone to carry the gold, which realised £4 per oz., the

Mangana Reefs Battery.

alue on the property, as the general range of the om £3 10s. to £3 14s. per oz. The stone at the e hill was exceedingly rich, and it is said that the he gold was obtained from there.

Adit.—This has been driven 720 feet. At the the reef has an unusual westerly underlay. It is small (2 feet 4 inches wide), and runs in soft us slate. As far as the Union shaft, the channel ky and uninviting, but after passing the shaft the mes harder. Its hanging-wall is smooth, and

footwall ragged. The level has followed a somewhat serpentine course. At about 250 feet north of the shaft the reef has been stoped up to No. 2. Just before this hard big stone comes in, and is exposed in the drive for a width of 9 feet. Some extraordinarily rich stone is reported to have been obtained from above this level—as much as 30 ozs. per ton. The shoot of golden stone appears to have been shorter in this level than in the one above it. I could not reach the end of the drive owing to it being blocked by a fall.

No. 2 Adit.—This has been driven 625 feet. Inside the entrance the reef is 7 feet wide, and there appears to be still more stone to the east. Quartz carrying gold 1 oz. per ton was obtained from here. Going north the reef attains a width of 12 feet. At about 100 feet from the Sovereign shaft the level is blocked by a fall of ground. The lode is said to have been lost in the end. The reef-channel has a westerly underlay in this adit.

No. 1 Adit.—This is the uppermost level, and has been driven 275 feet. The reef here consists of a channel of stone and mullock 20 feet wide. Near the entrance it is composed entirely of mullock. The quartz bodies here evidently make in bunches or blows. The Sovereign shaft, communicating with the apex of the hill, is 200 feet in, and there is a fine body of low-grade quartz here, estimated as worth a little under 4 dwts. gold per ton. From the large excavation seen, the stone has been worked up and down and in the side spurs. The reef becomes smaller after it passes the crown of the hill. In the end of the adit it is 3 feet wide, of which 18 inches are stone and the rest is mixed mullock and quartz. The sample taken from this adit by the manager and sent to London assayed 7 dwts. per ton.

Driving this adit 90 or 100 feet further would bring it out to daylight on the northern slope of the hill overlooking Sharkey's Gully, and No. 2 adit, if continued further 280 or 300 feet, would also emerge on the side of the hill, and even if driven only 150 feet it would come into country where it would have only 60 feet and less of backs.

These upper workings are evidently patchy, and the gold shoots seem short; but it seems to me worth while to relocate them and test the ground around and below them, so as to find some patches that would pay for working and relieve costs while development is going on at a greater depth. No. 1 adit might well be extended further

into the hill, and would have a fair chance of intersecting some of the principal shoots.

Workings from Main Shaft.

No. 1 *Level*, 115 *feet.*—The crosscut driven 29 feet south-west from shaft is in mottled stone and slate all the way. The drive north-west, 87 feet in length, is on the hanging-wall of the reef. Good stone has been driven on, and stone is still left inside the western wall of the drive. Solid stone is showing in the end. The reef has been worked from this level up to the No. 4, or main, adit, and down to the next level, 60 feet below, for a length of between 60 and 70 feet.

No. 2 *Level*, 174 *feet.*—This level has been driven north-west from the main shaft for a distance of 175 feet on the course of the reef. The reef is exposed in the chamber west of the shaft, showing about 5 feet of mottled quartz, nearly vertical. The stone has been taken out above this level for a length of about 100 feet. Fifty feet from the shaft is a short crosscut which intersects the reef, here 19 feet of mottled stone, dipping 50 degrees to the north-east. For 3 feet in this crosscut the quartz is very solid. Ninety feet beyond the crosscut solid stone 50 inches wide has been left standing, and the softer reef matter worked on each side of it. The west branch has been followed 10 or 12 feet, while the main drive has followed the eastern parting. Further north the stone enters the drive again, and the solid part of the reef widens out in the end to 19 feet. There seems to be plenty of quartz, and the problem is to find shoots of gold sufficient to pay for working. If this drive were continued it would meet the gold shoots from the hill workings.

No. 3 *Level*, 214 *feet.*—There is a wide band of reef matter here in the shaft, but the width has not been proved west. The formation is quartz and lode-slate. The level has been driven north-west at 12 feet west of the shaft, and continues on the reef for nearly 200 feet, but the end is partly blocked by a recent fall, owing to heavy rains. The reef as followed is $2\frac{1}{2}$ feet wide, consisting of mottled quartz and dark slate, with a good hanging-wall of black, greasy slate, dipping north-east. The slate forming the walls throughout the level is soft and mullocky. Old stopes exist above this level.

No. 4 *Level*, 319 *feet.*—A crosscut has been driven from the shaft north-east for 50 feet, and levels driven north-

west and south-east on the reef, the former for 150 feet and the latter for 125 feet.

Drive North.—The reef in this drive hugs the footwall side. The level begins on seams of quartz, and the formation is mullocky, which does not look very inviting, but the manager reports that it is worth 7 dwts. A cuddy east goes through slate seamed with flat veins of quartz, and fair stone (worth 7 or 8 dwts., I am informed) goes down in the sole of the level just opposite this. A little further north a rise has been put up to No. 3 level. Tributors worked here and did very well while the gold lasted, on a reef about 2 feet wide. Stone as high as 13 dwts. was got, but going up it grew poorer. Continuing in this level, some of the roof has been brought down by water, as the reef-channel is soft all the way. However, a change takes place in the end of the drive, and the first solid quartz in this level is met with. The face is solid white quartz, dipping north-east, at from 60 to 65 degrees. This stone is nicely mineralised. The manager informs me that it is worth about 3 dwts., but as there is fair gold at different points in the level the drive ought to be continued.

Drive South.—The reef is followed on the footwall side of drive, showing quartz veins 5 inches to 1 foot wide. The stone is said to be of good quality for this mine, and the manager recommends a rise being put up just south of the intersection of crosscut. The end of the level shows only dark slate with a few narrow veins of quartz. The drive here is apparently off the reef, and a short crosscut has been put in easterly 25 feet behind the end, but has only intersected a 7-inch flat vein of quartz. Some more cross-cutting is required to clear up matters.

No. 5 Level, 419 feet. A crosscut north-easterly has been driven 137 feet from the shaft chamber. At 150 feet it intersected the reef. Throughout the crosscut the slate country is much disturbed and intersected by quartz veins, which are often greatly puckered. For the greater part of it the veins dip west: afterwards this underlay changes to east. Some of the veins are quite horizontal.

The reef has been driven on north-westerly for 90 feet on a mullocky channel. It must have been rather difficult to choose the place for driving, as the crosscut is crowded with quartz veins; but the right selection has evidently been made. About 40 feet from the beginning of the level a few tons of stone were taken out over the roof, returning, I am told, about 3 ozs. gold per ton. This stone showed

no visible gold, but was mineralised with pyrite, copper pyrites, and galena. The channel here is 10 feet wide, but without walls. Veins of quartz appear in the roof and wall of the drive, and at half a chain from the end a small crosscut has been opened, showing a band of quartz dipping east. The end of the level is in silicified, barren country, intersected by seams of quartz, and consisting mostly of siliceous lode slate. Though no gold has been found at this point, gold-bearing stone is quite likely to be met with if the drive is continued, as in the level above a nice shoot, though very short, was left going down at about this distance from the shaft. This level seems to have been stopped on account of poverty of the reef, and because no funds were available for prospecting.

The level 200 feet below leaves too great a distance between the two levels. Either No. 6 might have been driven, or a winze sunk from this drive.

No. 7 Level, 619 *feet*.—At this level crosscuts have been driven north-easterly and south-westerly, and from the eastern one a level has been driven 170 feet on a small reef.

The eastern crosscut has been driven 260 feet, nearly to the boundary of the section. At its commencement a few stray bands of quartz from the formation which descends with the shaft are seen. At 38 feet from the shaft a 3-inch vein of quartz runs across the crosscut, and 10 feet further along is more stone in the form of irregular veins, and still further is quartz in patches. The country is twisted round in curves, and the dip consequently is variable, sometimes vertical, or even west, but reverts to its normal easterly direction.

A couple of small stopes above the roof of the level have yielded 5 tons of stone; the yield is reported to have been 7 or 8 dwts. The quartz is apparently in bunches, as clean country is left in the roof; but it was never wide in this level, the stone being from 8 inches to a foot. Fifteen feet behind the end of the level a winze has been started in stone 4 to 6 inches wide. The end of the drive shows lumpy quartz 3 or 4 inches wide in the upper part of the face, dwindling as it goes down to a mere track of black slate. If this is the reef driven on in No. 5, as it in fact seems to be, its underlay has become much steeper between the two levels, increasing in fact from 55 degrees to 75 degrees inclination from the horizontal.

The west crosscut has been driven 110 feet south-westerly from the main shaft. Veins of quartz connected with

the shaft formation occur immediately on the western side of the shaft. Three feet behind the face of the crosscut a formation of quartz and slate about 4 feet wide was passed through. The quartz veins, 2 and 3 inches wide, twist with the folds of the country, and the stone is white and barren. This reef is not so strong in the roof, where it is represented by a few 2-inch veins of quartz, but in the lower half of the drive it is fairly strong on both sides. The stone is not very attractive looking, but should not be passed by without a short drive being put in. The end of crosscut is in light-coloured slate, dry, and regularly laminated.

No. 8 Level, 719 feet.- A chamber has been cut here and a drive put in for 40 feet in a north-westerly direction. Stone is scattered all over the roof of the drive, but the channel proper seems to be 3 feet wide, and is filled with mixed quartz and slate. The country-rock dips in its usual direction of north-east, while the quartz veins underlie south-westerly. The quartz is vitreous looking. The shaft here carries a reef-channel 7 or 8 feet wide, which tails out in hard slate in the western chamber.

No. 9 Level, 819 feet.- The bottom crosscuts have been driven at this level.

East Crosscut.- This has been driven 140 feet north-easterly from the shaft. At 12 feet from the shaft a block of slate with veins and patches of quartz occurs in the upper part of the crosscut. The quartz has come down from the shaft, but nothing is visible in the floor of the crosscut, so this seems to be the bottom of it. In this drive there is a barren cross-course with a little quartz on its hanging-wall crossing in a north-easterly direction, about 2½ feet wide, and dipping north-westerly. The filling is dark slate. A little water is issuing from it, but the occurrence does not seem to be of any importance. In the end of the crosscut water is dripping, and a lode-channel of some sort is coming in with a north easterly dip. The proper position for the main reef, judging from its position in No. 7 level, is about 30 feet ahead of this point.

West Crosscut.- This has been driven 113 feet south-westerly from the shaft. In the shaft itself stone has been passed through all the way from the chamber above, and is seen in the western chamber in the form of torn bands of quartz up to 6 inches in width. At 46 feet from the shaft a dyke crosses the drive striking N. 20° W., and dipping south-westerly. Half way between this and the

shaft is a 3-inch vein of quartz visible in the roof, and 6 feet west of the fault is a patch of quartz, also in the roof.

It does not live to the south-eastern side of the drive, but its track in that side is indicated by somewhat softer slate. Just west of it some water trickles from the roof. When money is available, it might be driven on to make sure that nothing is neglected. Dish prospects have not shown any gold. In fact, no colours have been got from any trials at this level. The end of the crosscut is in grey slate, vertical, and very regularly laminated.

At 100 feet west of the shaft a drive is proceeding south-east on a reef-channel about 14 inches wide, and carrying in the end 5 or 6 inches of quartz. The footwall is smooth and well defined. The reef is nearly vertical, dipping at about 80 degrees to the north-east. Its filling is quartz and black lode slate. No mineral is discernible without washing. If the present angle of dip is maintained, this reef would enter the main shaft at about 280 feet lower down.

A small battery of 15 heads is situated at the mouth of Sailor's Gully, and is connected with the mine by tramway. The stamps are 7 cwts., and driven by a 14-horse power engine with Cornish boiler 28 feet by 6 feet 6 inches.

There is a Berdan pan with belt attached, and a sawmill connected with the plant for cutting all wood used in the mine; also an assay-house and furnaces, and a cyanide plant for treating the battery sand.

If the mine becomes payable, it will be by treating large quantities of stone, and for this the battery would have to be enlarged.

Everything at this mine is in good order, and the work carried out in a workmanlike and efficient manner. All that is necessary now is to settle the programme for future operations, and work with a definite object in view.

Reviewing the work done on this reef in former and recent years, it is undeniable that the deeper sinking has proved disappointing. The reason of this appears to be that the shaft has been sunk deep enough to pass out of the upper zone of gold-bearing stone, and not yet sufficiently deep to enter the second zone. The upper zone, as far as it has been proved, seems to occur in the reef from the surface down to about 200 feet, more or less. No stone has been taken out in quantity from lower than 300 feet.

Considering the developments in the upper part of the reef as being all connected with one another, and constituting a gold-bearing reef-shoot pitching at a rather low angle (30 to 40 degrees) to the south-west, there is a

probability that this will continue south-westerly into the adjoining section, which hitherto has only received desultory attention in the way of prospecting. Quartz has been cut in trenching at different points on this section on the slope of the hill falling towards Sailor's Gully, and I think this slope merits systematic exploration. Apart from the 300-feet level, no driving south has taken place from the main shaft, and it would be strange if the gold-bearing stone on the north of the shaft were not found on the south side as well. Exploring in this direction would necessarily mean following the stone successively to deeper levels. In addition to this work, it is worth considering whether the upper levels from No. 4 upwards, as well as the main adit, should not be continued north, so as to test the reef thoroughly below the hill workings. While this exploration work is in progress, prospecting might be undertaken in the upper adits, with a view of breaking stone that would at least pay crushing costs and relieve general expenses during search and development work down below. The whole proposition seems to be a low-grade one, and while considerable quantities of stone exist of a quality nearly payable, there is the chance that patches of sufficient extent may be found to raise the whole to an average that would pay for raising.

An alternative is to continue sinking the main shaft until another gold-bearing zone is met with: and such a zone, on the theory of parallel shoots, will probably in time be encountered, but at what depth it is impossible to say.

Underlay Reef.—This is on the company's property on the south side of Sharkey's Gully, bearing N. 5° W., and dipping easterly at about 30 degrees. It is thus a rather flat reef. At 5 chains south-east of the north-western corner of Section 1259 some very nice-looking quartz is exposed, laminated and impregnated with pyrites. This reef was worked between 30 and 40 years ago, and a trial crushing is reported to have yielded 6 dwts. It has been cut into for two or three chains, and seems to be fed by spurs of stone. One of these spurs is about 15 inches wide, a lode in itself. The reef is exposed to a width of 18 or 20 inches, but cannot be well examined, as the entrance to the underlay winze is blocked by a fall of stone. The workings now are evidently in a state that would discourage some from doing anything with the proposition, but the reef, *per se*, is somewhat attractive. It crosses Sharkey's Gully and passes north right through the old Union Jack section to the Fingal Mine in Grant's Gully, where it was worked

rather extensively. Reports of values vary from 6 to 10 dwts. On the south side of Sharkey's Ravine the reef strikes across a hill spur which would only allow of short and shallow drives on the reef-course unless a sufficient depth were secured by a shaft.

(b) Golden Entrance Mine.

Sections 1547-93G, 1569-93G, and 1568-93G—10 acres each.

This mine has been working intermittently since 1900, and is now being exploited on tribute by Messrs. Madden and Macleod. The reef was discovered by Mr. J. S. Goodall, Jun., since when 1050 tons of stone have been crushed for 2801 ounces of gold, of the value of £10,264 9s. 11d., averaging 2 ozs. 13 dwts. 8 grs. per ton. The first crushing yielded 39½ ozs. gold per ton.

The reef crosses Sailor's Gully. About 20 feet above the track on the north side of the gully a small cutting was made into the reef nine or 10 years ago by Mr. Goodall, and a little gold said to be obtained. A body of slate and quartz has been exposed for about 10 feet, and some blocks of solid quartz thrown out.

Lower Tunnel (No. 2).—This is aout 150 feet above the gully. Angle of slope of hill, 30 degrees. The adit has been driven on the reef for 150 feet in a north-west direction. The reef dips east here, while there is a local underlay of the country to west. At 20 feet in is a shallow winze 7 feet, sunk on material carrying a little gold. The reef-channel is filled for the most part with soft decayed slate, with a rather regular veinlet of quartz and a few bunches of quartz in the formation. Six-inch veins of quartz cross in the roof and east wall. Those in the roof are rather solid, but on their strike they die out and are replaced by slate. Twenty-five feet behind the end the country-rock is a more massive and siliceous grey slate in the lower part of the drive. In the upper part a cross-course comes in, striking west and dipping north 55 degrees. The level has been driven through to the north wall of the cross-course, and has touched the siliceous wall-rock, which is freely impregnated with pyrites. Driving has stopped here, but it is not clear that the reef has been heaved. If a displacement has taken place the reef, according to the laws of faulting, should be sought to the west. The workings ahead show that there cannot have been much dislocation, and the best way would be to drive on and put in short crosscuts.

Winze Adit (No. 1).—This is 180 feet above the lower adit, and has been driven 270 feet on the reef on a course varying from N. 40 degrees to 46 degrees W. The reef dips north-easterly, and the country south-westerly. At the entrance a winze has been sunk to 100 feet on the hanging-wall, with a very steep dip. A little way in the adit is an air-pass to the level below. The stone stoped was from a few inches to 7 feet in the widest part. At 140 feet in the No. 2 shaft from surface passes through this adit. Half a chain beyond the shaft a fall of ground has blocked the level, but it has been driven 2 chains further north. The timber in roof prevented examination, but the stone above here was very rich—6 to 7 ounces gold per ton. This was not continuous, but in patches. Only a little stone is now seen in the level, clinging to the east wall. The channel is filled with black greasy slate and pug.

Twenty-five feet below the level is an intermediate drive, which has been driven both ways. The south drive is for about 40 feet, and carried good stone. I was informed that 81 tons were taken out for 289 ozs. The reef varies here from a few inches to 2½ feet at the widest. The south drive has been mostly stoped up to the level above, except just near the shaft and towards the south end.

No. 2 Level.—This is 45 feet below the collar of the main winze, and connects No. 2 shaft and winze. Towards the south end near the winze a small sink was made 6 feet below the floor of the level, and 50 tons of stone taken out and crushed for about 350 ozs. of gold. This was the last parcel mined and sent over to the Bairnsdale School of Mines for treatment. Just south of No. 2 shaft a pass goes down 24 feet to an adit driven from the north side of the hill.

The stopes above this level were in stone up to a foot in width. The sink referred to above shows quartz going down on the east side of the drive for a couple of inches wide only, but exceedingly rich stone was obtained from this point.

No. 3 Level. This has been driven from the bottom of the main winze (No. 3 shaft) for 10 feet south and 50 feet north. The chain ladder had been taken away from the bottom, so these lower workings could not be examined. About 20 feet below No. 2 the track of the stone passes through the shaft corresponding with the southerly pitch of the make of quartz, but all along the No. 2 level there is very little stone.

Surface.—North of No. 2 shaft the outcrop of the reef twists in a serpentine way to the west, and resumes its normal bearing when it reaches No. 1 shaft. This change (accompanied by a flattening of the underlay) is also seen in the stopes above No. 1 level, but not in the level itself.

No. 1 Shaft.—This is 250 feet north of No. 2 shaft, and has been sunk to 108 feet. It is the point where work was first done on this mine. When 30 feet deep 480 ozs. of gold were won from 24 feet by 30 feet of reef, and one parcel of 4½ tons is stated to have yielded 25 ozs. per ton. A few tons of gold-bearing quartz are lying outside the shaft, but were not considered rich enough to send away. There is a fair amount of pyrite in the stone, and the gold occurs in rusty patches, which represent decomposed pyrites. This probably accounts for the unusual richness of the quartz in free gold.

At 50 feet a level has been driven 30 feet south and 50 feet north. The ground has been stoped south for 15 feet from over the back of the level to surface, and north for 30 feet to 20 feet high. At 80 feet down, drives have been put in for 17 feet south and 30 feet north, and 20 feet north of shaft a winze connects the two levels.

No. 4 Shaft.—This is 31 feet north of No. 1 shaft, and has been sunk on the reef to a depth of 30 feet by the present workers. A few tons of stone have been raised, but not enough to send away yet. It is situate on the south brow of the hill, about 1566 feet above sea-level.

Sharkey's Gully Adit.—This has been driven on Section 1568 from the north side of the hill first as a crosscut in slate for 420 feet, and then on the course of the reef as far as 30 feet south of No. 2 shaft, and 24 feet below No. 2 level, with which it is connected by a pass. At first the reef-channel is about 2 feet 6 inches in width, filled with quartz and soft country. Near the end a little gold was met with, where there were a few inches of quartz and a soft "dig," about 18 inches altogether. The stone is mineralised.

A characteristic of the Entrance reef is a little parting, which forms a track that can be easily used as a means of identifying the reef. The stone occurs on each side of the soft parting.

General Remarks.—There is abundant scope for useful exploratory work at this mine. The bottom level on the south side of the hill should be extended so as to bring it below the upper workings, and shafts Nos. 2 and 3 deepened to connect with it. The ground below No. 3 level

and south of No. 3 shaft may be expected to carry the continuation of the shoot which was stoped above, but below a certain distance from the surface the lode enrichment will possibly be found not to continue. The reef in depth will then have its normal characteristics. If necessary, a lower tunnel can be put in from Sailor's Gully below No. 2, at a spot where there is a fine body of stone at surface, and fairly mineralised.

(*c*) *Alpine, Buckland, and Cardinal Mines.*

The mountain spur between Richardson's Creek and Calder's Gully comprises parts of two 320-acre blocks owned by C. and H. J. Buckland. Some important reefs have been worked on this spur, and several others have been discovered and trenched upon at surface.

Alpine Reefs.—These are about 1000 feet above Mangana, on the western of two sections once held by the Alpine Company, north of and adjoining the Buckland Gold Mining Company's section. The reefs were discovered by Mr. J. C. Goodall in 1877. About the centre of the section they appear to unite, and form a single reef, which continues north beyond the limits of the section, and disappears under a capping of Permo-Carboniferous conglomerate. The two reefs going south vary in width, but attain a maximum of 2 or 2½ feet. They seem, however, to be only a few feet apart, and perhaps may be better considered as one reef formation. An adit has been driven at 100 feet lower than the outcrop, and the reef stoped upwards. The Alpine Company erected a 10-head battery at the mouth of Calder's Gully, constructed an incline and tramway, and got between £2000 and £3000 of gold. Stone from the winze sunk to 100 feet below the adit is stated to have returned gold at the rate of 18 dwts. per ton. A low adit was started down in Calder's Gully, which it was calculated would give 600 feet of backs. This was driven over 400 feet, and from the face a horizontal diamond-drill bore was put in for further 545 feet, making 945 feet altogether, without reaching the reef. Mineralised rock was shown in several of the cores. According to the survey the eastern reef should be 600 or 700 feet ahead of the bore.

Buckland Reefs.—The Buckland No. 1 reef was also discovered in 1877 by Mr. J. C. Goodall, and an adit driven which intersected it at 160 feet. A winze was sunk 110 feet on it, and levels opened out on it north into the Alpine ground at 45 feet and at 70 feet. These were con-

ected by a winze, and an underlay winze was also sunk om the 70-feet level a further depth of 50 feet. At the -feet a level was also driven north. A good deal of stone as broken, which has been reported as having yielded om 12 dwts. to over 1 oz. gold per ton. Mr. J. C. Good- informs me that 1319 tons quartz were broken, return- 1001 ozs. 13 dwts. gold, during the time that he was ne and battery manager—September 7, 1883, to Sep- ber 16, 1884. The last 80 tons crushed during Mr. ter Irvine's managership were from the lower levels, and e 38 dwts. per ton.

At the tunnel level, 110 feet from surface, the length payable stone, according to plan, was 85 feet, and ond that, in a southerly direction, the drive was ended 150 feet, but met with no payable stone. The artz stoped below this level seems to be pitching north, d at 30 feet down the mine plan shows a new shoot of d as having come in, and continuing downwards in ne 5 feet wide. These workings are inaccessible now, so re are only reports to go upon, but these are from ner managers who were well acquainted with the mine. . Peter Irvine, who is still a respected inhabitant of ngana, says the average width of stone was 3 feet, and average quality all through equal to 18 dwts. per ton.

The low Alpine tunnel was unfortunately abandoned fore success was achieved. At present too little is known the reef to warrant such a long adit at such a depth, but entually, if work at more moderate depths proves satis- tory, it may become advisable to extend it. For the esent a more desirable course would be to prove the reef an adit a more reasonable depth below the present rkings.

Cardinal Reef.—This is on the western brow of the spur, d near its southern end. Its bearing is N. 28° W., and dip south-west. Three shafts have been sunk along the e of reef. The principal one, I understand, is 100 feet ep, but none of them can be entered in their present ndition. Complete figures relating to the former output e not available, but accounts point to 167 tons being ised from the 50-feet level stopes, returning 13 dwts. ld per ton. Some of the stone is said to have gone as gh as 35 dwts. The reef in the bottom was not payable. r. Goodall, who has come to my assistance with many luable statistics of this field, tells me that the reef in e south end was 4 inches to 12 inches wide, and in the rth end about 2 feet, but poor. Mr. Macleod states

that tributors crushed 20 tons of stone left at the shaft for 8 or 9 dwts. per ton, and some odd parcels gave from 15 dwts to 1¼ oz. The Cardinal is in a reefing line which embraces some parallel reefs, one of which at least is of considerable size. Mr. Goodall has done a good deal of trenching in this zone, north of the Cardinal shafts, and has exposed a strong reef of solid quartz in half a dozen trenches and an open-cut at intervals for over 4 chains from south to north on the N. 20° W. course of the reef. The first trench is about ¼-mile north of the Cardinal shaft, and west of the Cardinal reef. A hundred feet north of this trench is the open-cut, which has been carried down 16 feet, showing solid stone 8 feet in width. Apparently this reef is widening as it runs north, for it was not more than 4 feet at the most southerly trench. The most northerly trench (which I did not see) is reported as exposing 17 feet of quartz. The open-cut has given gold prospects, and prospects obtained from surface loam lower down on the slope indicate a possible source in this reef-belt, which is about 100 feet in width. The reef in question has been called No. 1 reef, on the Buckland Freehold, which leads to confusion with the old Buckland No. 1 Company, which worked a different reef altogether. As it is such a prominent reef, and is a permanent land-mark on this ridge, it might be called Goodall's No. 1 reef, for sake of distinction.

Adit prospecting suggests itself for any one undertaking mining here, as adits could easily be laid out to go right below the outcrop at any depth desired. As for the Cardinal reef, it thins as it comes north, and is apparently replaced by Goodall's No. 1.

It will be noted that both country and reefs on this hill dip to the south-west, being on the western half of the Fingal Valley anticline. The quartz of which the various outcrops consist is the massive white variety which so often characterises the surface exposures of the reefs of the Mangana field, and in some districts might be looked upon as unfavourable. Experience at Mangana, however, has shown that high yields of gold have been associated with vitreous-looking quartz, which is often intersected by oxidised partings, forming a favourite matrix for gold, and which in depth frequently changes its character altogether and becomes a mottled, laminated stone, with a fair proportion of mineral. Whether any particular 'buck' reef will behave in this way is another question, but at any rate the vitreous habit of the quartz is, per se, not sufficient reason for condemning the reefs.

(*d*) *Tower Hill Mine.*

This is an abandoned mine on W. Gellibrand's purchased land, 157 acres, 3 miles north-north-west from Mangana, and over 1000 feet above the township. Like so many of the Mangana reefs, this one was discovered by Mr. J. C. Goodall, in 1869. It was worked by a Hobart company, and Mr. Goodall tells me that at first several crushings of good stone were taken out (up to 2 ozs. per ton), but after some poor battery-runs work was suspended, and has not been resumed since, except by co-operative parties. No very clear idea of the reef can be formed from the workings in their present condition. It has a north-westerly bearing, and shows at surface about 4 feet of white mineralised stone, disappearing to the north. The mine is on the spur between Golden and Fern Tree Gullies, with adits driven from the eastern side.

About 5 chains south of Gellibrand's boundary are some cliffs of Permo-Carboniferous conglomerate and soft quartzose sandstone, with embedded pebbles of white quartz and slate; and nearer the mine sandstone, belonging to the same system occurs also, though the reef itself is in the older slate. The slate dips south-west. The reef has a north-east dip.

Descending hence down Fisher's Hill, towards Mangana, on the west side there is a good deal of loose quartz, heavily charged with arsenical pyrites. The hill consists largely of grey sandstone, freely veined with quartz.

I did not see the Golden Gully Mine, which is a little way up that gully on the east side. I am informed that some fairly nice stone occurred on surface. An adit was driven with 50 feet of backs, but though there was a good body of mineralised stone it was barren of gold.

On the west side of Major's Hill outcrops of quartz have been tested a little. Some of these have a kindly look; others are hard and white. On the ridge, which is a razor-back, are stones of quartz of fairly loose texture.

These hills north of Mangana do not appear to have had the work done on them which their reefs would require. Some of the alluvial gold found in the gullies must have been derived from them, and their lines are too long and persistent for gold not to exist in them at some point in their course.

The reef-line on Robertson's Freehold, further south, seems to correspond with the Major's Hill line, and the Buckland Hill line with the sections on Otway's Creek.

(*e*) *Fingal Company's Mine.*

This was worked at least 40 years ago, on Grant's Creek. The greatest depth attained was 170 feet, and the mine does not seem to have been a payable one. The workings are 2 chains from W. Robertson's boundary, on Tully and Downing's land, and are on two parallel reefs a chain apart. Most of the gold was got out of the western reef, which is supposed to be that of the Golden Entrance. A good deal of hard white quartz is lying about at surface. The eastern reef was worked about 100 feet down on the underlay, and corresponds approximately in position with the line of the Union Jack and underlay reef further south. The battery which was formerly here is supposed to have recovered 6 or 7 dwts. from the stone. Mr. Cundy worked out some blocks of stone here 10 years ago, and got 6 dwts. per ton.

This is the furthest north that these long reefs have been seen. It is a remarkable instance of the persistency of the reefs at Mangana. In this instance the Golden Entrance reef would be shown to have a length of 1¼ mile, and the underlay reef ¾ mile.

(*f*) *Union Jack Mine.*

This reef is the continuation of the underlay reef, which passes up the hill north of Sharkey's Gully into Section 1527-93c, which is the old Union Jack claim. A little north of the south-west angle of the section is an ancient adit, which has been driven on the course of the reef for 250 feet. The latter still has a flat underlay to the east. In the adit about 8 inches of stone are showing at first, but further in it becomes softer and somewhat broken. At 200 feet in an underlay rise slopes up to a shaft which was sunk from surface. The inclination of the reef is sufficiently flat to walk or scramble up the rise. The shaft is 70 or 80 feet above the adit. Above the latter is an upper tunnel, driven right through the crown of the hill, with only 30 feet of backs at the most. The entrance to this is now fallen in. From the bottom of the shaft a small parcel of 1-oz. stone was taken. The quartz used to be trammed from the upper tunnel along a horizontal tramway for 150 feet west, and sent down an incline to Sharkey's Gully for treatment in the old Union Quartz Company's battery. The reef is so flat that it crops out at surface at 100 feet west of the tunnel and 12 or 15 feet above tunnel level. It cuts the country, being much flatter than the parting planes of the slate. The

appearance of the stone corresponds well with that of the underlay reef in Sharkey's Gully.

Five or 6 chains east a large reef crops out, with an easterly underlay. It is 12 feet wide, and has the characteristic central parting of the Golden Entrance reef, which, in all probability, it is. It is strongly mineralised with pyrite and iron oxide. The eastern portion of it is the more solid. Its bearing is about N. 40° W. It has been trenched upon in one or two places, the most northerly being 80 feet south of the southern corner of Section 1589. This should be driven on lower down the hill, and a rise would then cut the underlay reef as well.

What is probably the same reef has been cut further north, on W. Robertson's eastern block, where a shaft has been sunk on it. It shows there solid quartz about 1 foot in width. A few feet further north a cut has been put in, but not deep enough to expose any quartz. About 200 feet lower down, going north on the same course, is a small pit, about 12 feet deep, of which 6 feet consist of hill debris or overburden. Doubtless the same reef continues to the old Fingal workings.

It is impossible to form an opinion of these reefs from the abandoned ancient workings, but if any work was justified then, there would seem to be warranty for further testing them.

(*g*) *Pincher Reef.*

This reef is on the hill east of the township, where it overlooks the entrance to the Fingal Valley, or Grant's Creek Valley. Some tunnelling and shaft-sinking have been done on it, but how much stone has been taken out cannot be seen, neither are results available. It has a strike of N. 50° E., and dips south-east at an angle of 70°, and shows a width of 2 feet 4 inches stone between walls. The country is hard sandstone.

(*h*) *Specimen Hill.*

This is a low, somewhat flat-topped hill, on Robertson's Freehold Blocks, west of the township, covered with wash on the lower slopes. A little surfacing has been done with encouraging results, but there is not enough pressure of water available. The crumbly quartz detritus lying on the surface has apparently been shed from a series of veins running through the hill in a north-north-west direction, and forming an auriferous belt of about a chain in width. The slate strata crop out on the top of the hill, striking N. 20° W., and dipping south-west. On the

southern block of the freehold property stones of Permo-Carboniferous grit and mudstone are scattered over the ground, and it is probable that there is an occurrence of beds belonging to that system *in sitû* somewhere near here. This would indicate that the undiscovered fault which has brought these beds down from the upper level to the Fingal township horizon must pass north of this. On the two northern freehold blocks diabase comes in, and passes away to the west as an intrusion, cutting-off the slates. Its former Permo-Carboniferous covering has been entirely removed by denudation.

Some shafts have been sunk at intervals on the line of quartz leaders and veins. The most southerly is the Trilby shaft, which is 50 feet deep. Some very nice gold was got here on Crown land, a chain inside the east boundary of 829-936, 10 acres. A quartz gold-bearing wash rests on a yellow clay, which covers the slate bed-rock. North of this several trenches have been cut and quartz veins exposed. The depth of the wash varies from 8 inches to a foot.

Further north, in the freehold land, is Goodall's shaft, near the top of the hill, which has been sunk on a mass of quartz leaders. Quartz detritus lies here everywhere on the surface. The shaft was sunk 40 or 50 feet 12 or 14 years ago. Just below it a strong body of hard valueless quartz has been exposed.

Brennan's tunnel is an adit which has been driven into the hill on the western side for about 200 feet, at a shallow level, not more than 30 feet below the crown of the hill. It was put in with the intention of cutting the reef, but only one or two veins were intersected. This was about nine years ago. I do not think the position selected was a favourable one for the best results, as if the adit were continued, it would eventually emerge on the east side of the hill above the leaders there. A few stones of white barren quartz are seen on the tip.

Some trenching has been done in the depression running down the east side of the hill, and passing through a belt of small veins, some of which are oxidised and have a kindly aspect; others, however, being hard and white. A tunnel was put in on this side some years ago, and a flat vein near it carried very fair gold. There is an old shaft just above the tunnel with quartz going down in the [illegible]. Near this point [illegible] the head of the gully workings.

On specimens [illegible] yet a shaft was sunk eight or nine years ago for Mr. [illegible] a depth of 130 feet in slate, dipping south-west. On [illegible] gold-bearing leaders

were passed through in sinking. From the bottom a crosscut was driven east. I was informed that nothing was won from this, but some nice specimens were got from trenching near the shaft. A few tons of quartz and slate were sent away for crushing, and returned about 5 dwts. per ton.

In the earlier days many of the auriferous leaders on this hill were pounded up and washed. Just north of this point diggers started on the alluvial gold shed from this hill, and kept working round the foot and up the gullies, in which a considerable quantity of gold seems to have been concentrated. There has been so much gold obtained in this way from the surface that it is next to certain that more exists at a depth. Whether the numerous veins unite in depth and form a strong reef-channel can only be ascertained by actual work, but it is, to say the least, probable that they do. The hill being so low in elevation (50 to 100 feet) adit-driving cannot be thought of. Mr. Montgomery advised sinking rows of shallow shafts and connecting them by drives. This would be useful preliminary work, but the real work of testing the reef or reefs would best be carried out from a shaft sunk to some depth, and well below the broken ground, which may be expected to prevail above the level of the Mangana Valley. A water scheme has also to be devised.

(*i*) *Alluvial at Mangana Generally.*

The actual lead or ancient bed of the tributary which flowed formerly from Mangana into the valley now occupied by the South Esk, a good deal below the present bottom of that river, cannot be traced with confidence above Mangana township. The ground at the mouths of the present mountain creeks does not exceed 40 feet in depth, and has no doubt accumulated from the creeks which flow down narrow ravines of comparatively recent origin. All these valleys have given employment to diggers, who have at different times worked some of the ground over and over again. The alluvial ground below Mangana deepens towards the South Esk, and, probably owing to it being private property, has never been thoroughly tested. It must have received a certain amount of gold from creeks which have now disappeared with the erosion of the country, though owing to the direction of the lead coinciding with that of the strata, and being parallel with the bearing of the principal reefs, the quantity of gold finding its way into the drift is likely to be

less than if the main valley crossed the strata. If the land had been open for mining its value, no doubt, would have been tested ere now.

It is difficult to ascertain how much alluvial gold has been won at Mangana. An estimate made in 1884 placed it at £60,000 worth, and assigned 6000 to 8000 ozs. to Major's Gully alone. Later estimates state 5000 ozs. as the gross returns. No figures pretending to any degree of accuracy can be obtained.

Major's Gully is said to have supported 400 diggers at one time. Near its mouth the ground is deep and wet, water flowing beneath the shingle, which chokes and hides the channel from view.

(*j*) *Conclusion.*

The present condition of Mangana, considered as the earliest goldfield in the island, is somewhat pathetic. It has been left by investors on one side, while the stream of capital has flowed to other centres. And yet the phenomenal returns from some of the reefs should suggest that there is here a legitimate field for search. The reefs, too, are in the golden zone, which extends for such a distance in this part of Tasmania. Some of them are barren, others are gold-bearing, and the chances appear to be neither more nor less than those of other parts of this auriferous belt. The Mangana Reefs is the only property on which anything like deep work has been done; the workings on other reefs are shallow, and often mere scratchings. Mangana evidently has not had a thorough trial yet.

W. H. TWELVETREES,
Government Geologist.

Launceston, 22nd November, 1907.

THE MATHINNA GOLDFIELD.

PART III.

[Two Plates.]

I.—INTRODUCTION.

THIS part of the Mathinna Report deals with a comparatively small and outlying portion of the field, situate round the Scott and Pickett Mine in the upper part of a narrow valley which joins further north with that of the Sling Pot Creek, forming then one broad flat between the Volunteer and the Volunteer Consolidated spurs.

The slate and sandstone strata in which the Scott and Pickett valley has been carved out belong to the Ordovician auriferous series prevailing at Mathinna and Mangana. In respect of position in this series, they occupy a line of country apparently between the Golden Gate and Consols line on the north-east, and the Mangana line of country on the south-west. This line would embrace the strata on the mineral sections north of the Tower Hill farms.

II.—PHYSIOGRAPHY.

About ¼ mile north of Densley's land, the Sling Pot or Bull Bottom valley contracts, and the Sling Pot Creek forks off in a slightly west of south direction, leaving the Bull Bottom or Scott and Pickett valley heading a little south of east. The latter valley is now not more than 500 feet wide, but up at the mine narrows to a mere "V" shaped ravine. The valley and the hillsides are clothed with fine timber, comprising stringy-bark, iron-bark, peppermint, swamp, or white-gum, some of the trees from 10 to 20 feet in girth. A few small farming selections have been taken up along the valley, but the soil is none too fertile, and there is a deplorable dearth of water. After the spring snow-waters have descended from the mountain the creek subsides into its normal trickle from pool to pool, percolating through the sandy soil, and of little use either for farming or mining. The elevation of these farms is about 1100 feet above sea-level.

Above the Scott and Pickett battery the sides of the valley draw closer to one another; the slopes are steeper,

The sky-line on the tableland above is visible at a height of 500 and 600 feet. This is the high plateau connecting Mathinna with Tower Hill, which is between 3 and 4 miles south-west. The drainage of this part of the country is northwards into the South Esk River.

III.—Geology.

The strata of this part of the field are similar to those of the Mathinna field proper, and are of the same geological age. Alternations of soft, glossy clay slate, decolourised in the superficial zone, with sandstone and sandy slate occur everywhere. The sandstone is generally tough and crystalline, and constitutes locally the "hard" country of the miner.

The general direction of the cleavage planes of the slate and the laminations of the sandstone is from N. 20° to 30° W., and the dip or underlay to the south-west. A singular variation of dip is seen in the battery building of the Scott and Pickett Company, where the slate dips to the north-east at an angle of 45°. I have not seen this dip anywhere else on the strike of these strata, and the normal westerly underlay prevails to the immediate east, and also to the west, across the valley. It must, therefore, be a purely local disturbance.

The dominant dip of the strata to the north-west in this area, continuing also north-east to the Gladstone and Eldorado Hills, seems to show that the whole of this belt forms the west side of the anticlinal arch of the New Golden Gate and Tasmanian Consols line, to which I have referred in my previous reports.

About 500 feet above the Scott and Pickett, or 1700 feet above sea-level, stones of grit and conglomerate begin to appear on the hillside. These can be traced up to the plateau, where this formation covers the older slate. It belongs to the Permo-Carboniferous, and has been described in my recent report on the Mangana Goldfield. Its occurrence shows as plainly as anything could do, that the slate and sandstone strata of this field could not have suffered any very great loss by denudations before they were covered up and protected by the layer of conglomerate, which must once have spread in a wide belt all [illegible] country.

[illegible] the occurrences of diabase [illegible] and on Tower Hill, [illegible] connection with the auriferous [illegible]

IV.—Economic Geology.

Not many reefs have been opened upon in this part of the field, but the few which have been discovered belong to groups of the pyritic and arsenical gold quartz reefs. They are small, varying mostly between 15 and 21 inches in width, but, as a rule, are persistent, as far as their channels are concerned, for considerable distances, though the development of stone may be irregular. When shoots of gold occur, the value of the stone ranges from 1 dwt. per ton to, perhaps, a little under an ounce.

The associated minerals in the different reefs are pyrite, arsenopyrite, copper pyrite, galena, and zinc blende. Stone has been found with all these minerals, yet without free gold, nevertheless it is safe to say that they are reliable indicators of the presence of the precious metal in the reef. The quartz of these reefs varies in nature from a brittle, milk-white variety, which, though often barren, sometimes shows galena and free gold to a bluish-grey arseno-pyritic variety, forming one of the best-looking kinds of stone on the Mathinna field.

All the reefs which I have seen are fissure reefs, transgressing the strike of the country strata. One set has a strike about N. 20° E., while the direction of another is N. 75° W., crossing the first at nearly a right-angle.

V. Mining.

The reefs which have been discovered are few in number, but I doubt not that others remain to be found, for the overburden in the form of hill debris is so constant that the bare rock is seldom seen on the slope of the hills, and the only chance of unearthing a reef is by closely observing the small ravines which score the hillsides. There has been no very extensive prospecting, which is hardly to be wondered at, for to prospect effectively here means the expenditure of considerable time and money in opening-out long and deep cuttings, almost at haphazard. The cuttings must be deep, so as to avoid passing over the caps of lodes, which do not always come right to surface.

The reefs dealt with in this Report are:—

(*a*) The Scott and Pickett reef.
(*b*) The Commercial reef.
(*c*) The Pride of the Hills reef.
(*d*) O'Brien's reef.

(*a*) *Scott and Pickett Gold Mining Company, No Liability.*

Sections 525-G, 10 acres; 526-G, 10 acres; and 534-G, 5 acres.

This property is situate nearly 2½ miles south-south-west of Mathinna as the crow flies, or about 3 miles by road. It is on the east bank of the valley, which debouches further north into the marshy flat known as Bull Bottom. The battery is about 200 feet above Mathinna. The small creek which feeds it with an intermittent and inadequate supply of water flows past it down the valley through the farm lands to the north. A road has been cut recently right up to the property, though, as it is a little rough near the mine, carters look askance at it.

Mr. Pickett, prospector, was the discoverer of the reef, and the company bears his name, and that of his companion, Mr. Scott. The reef is an arsenical gold quartz one with a strike of N. 27° E., and dipping, on the whole, steeply to the north-west. This dip prevails at surface and down to the bottom level where the reef becomes nearly vertical, or shows a tendency to dip slightly to the east. This bending of the reef is probably a purely local feature.

Adit No. 1, South. South of the shaft an adit crosscut has been driven 57 feet to the reef, which has been followed in a drive south-west for 110 feet. The reef-channel is a fracture line in the slate and sandstone strata, which course north-west at a right-angle to the reef.

Four trenches have been cut across the line of reef higher up the hill, north of the end of this adit level, mostly without exposing anything else than yellow, soft clay slate. The highest trench shows hard laminated sandstone, seamed a little with quartz.

On the opposite side of the small gully are several openings on the line of reef going south. One of these is a shaft where the reef has been stoped to surface. Further south, quartz is shown in a trench which has been cut on its course for about 10 feet. Trenches still further south do not show the reef, being probably too shallow.

No. 2 Adit Crosscut. This was driven into the stope on this side of the hill, and has now fallen in. It was put in by the prospectors before the claim was floated into a company.

Main Shaft. To prove the reef at a depth a 12-foot by 4-foot shaft, at 84 feet above the battery, has been sunk 62 feet plus 2 feet well, and a crosscut driven from the bottom for 82 feet in a south-easterly direction. The reef was cut through at that point, and levels driven on it

north-east and south-west. The channel here is 2 feet wide, with a 4-inch vein of clean quartz, the remainder being scattered quartz, pug, and slate.

North Drive.—Going north, the quartz increases to a width of 14 inches, but after 20 feet the stone dies out, and its line is replaced by a track of pug. Further on, the present manager has picked up a little quartz, 6 inches wide. A little gold has been carried from here to the face, and for about a foot it was shown to be payable. Beyond this is stone 10 inches to 12 inches wide, but with only a trace of gold, which continues in the roof. The reef in the face is 32 inches wide, with 3 or 4-inch bands of quartz interlaminated with slate. A pug seam occurs on the west wall, and on the east side is a lot of twisted greasy slate, favourable for reef formation. The slate foliae have twisted round to a course of N. 55° E., dipping south-east.

This is the most favourable-looking end in the mine. It is 50 feet behind the entrance of No. 1 north adit level, and something may occur between this and that. The upper level, also, is too near the surface to give satisfactory results in the first 100 feet. The owners will no doubt continue driving this end.

South Drive.—At about 10 feet south of the cross-cut gold began to make in the stone, which is from 10 to 20 inches wide, and has been followed up to the surface. Occasional bulges of stone, 3 feet in width, occur. The quality of the stone is said to improve as it goes up, but its length is dimishing. The length of stoping-ground at the drive level was about 30 feet, and there is said to be good stone going down. Beyond the south end of the stopes the track of the reef is marked by a line of pug, with a little barren quartz here and there. The face in the end of drive has a little water issuing from it. It consists of sandstone seamed and intersected by quartz veinlets, and has a line of pug on the west wall. There has been some twisting of the country here, as the strike of the strata coincides with that of the reef.

Where the reef was cut in the adit it was puggy for a width of 8 inches, and slightly mineralised. Here it was not gold-bearing, and it gives place along the level to quartz 4 or 5 inches wide, but still without gold. At 20 feet from the flat sheet payable gold came in, and the reef has been stoped up to surface about 50 feet above the level. South of this shoot of stone there is only the puggy track of the reef visible, with a little quartz here

and there. I am informed that a little gold can be got from prospects along the floor of the drive: but this part of the level is evidently south of the shoot of stone which has been worked. As this pitches north, of course, higher up it has existed further south. In the south end of the level is a little pug, otherwise the face is in country sandstone, with slate on the west wall. I am told that all the crushings prior to the time of the present manager came from this block of stone.

Adit Level No. 1, North. One hundred and seventy feet north of the south adit the reef has been driven upon from surface in a north-easterly direction for 100 feet without disclosing anything of particular value. At about 25 feet in a short shoot of 3-inch to 4-inch stone occurs on the west wall of the drive, and further in is a 1-inch vein of quartz associated with a bit of pug. Just behind the face a cuddy has been driven west for 6 feet. In the end of the level the face shows an inch or two of pug, and the rest is slate. This adit being in the slate belt and not far from surface is in soft country all through.

The official figures furnished by the company give the crushings taken from the mine as 92 tons for 38 ozs. 4 dwts., but a little uncertainty exists in respect of the tonnage. Further 80 tons are now being crushed at the mine, and the yield is estimated as likely to be somewhere in the neighbourhood of 15 or 16 dwts. per ton. When this crushing is finished, all available stone will practically be worked out, and the company will have to consider its programme.

A short shoot of stone like that in this mine can only be followed down by a shaft, and a further sink would show whether the reef widens as it descends. With its present width and value it could hardly be worked profitably [illegible] out, of course, if it increased in width the [illegible] be more hopeful. The present shaft [illegible] country, but the bottom [illegible] to the east, which underlay may be expected in further [illegible] that at Mathinna, where- [illegible] worth while to follow [illegible] occurring. It is [illegible] shoot of gold in the [illegible] obviously a fresh shoot [illegible] ing south, but at a [illegible] it may be found [illegible] stone lengthens.

The continuation of the bottom drive north would be of an exploratory character. At about 20 chains north-east of the shaft an intersection by the Commercial reef takes place, according to the observed bearing of the latter; and in driving there is always a chance of meeting with intersections by reefs now unknown.

The quartz of the Scott and Pickett reef is for the most part a bluish grey quartz, carrying a great deal of arseno-pyrite, with a little iron pyrites, zinc blende, galena, and copper pyrites. Large specks of free gold are not uncommon, especially in the whiter variety of quartz.

The 10-head battery attached to the mine would have to be improved if regular work were carried on; and a scheme for conserving water would also have to be devised. The present arrangements for crushing, conveying stone from mine, and conserving water are all impossible.

(*b*) *The Commercial Reef.*

This is on Sections 1292-93G, 10 acres; and 1293-93G, 10 acres; lying N. 80° E. from the Scott and Pickett, and on the brow of the hill, 500 feet higher up. The little gully in which the shaft is situate forks in two branches higher up the hill, and the Commercial sections are on the spur between the branches, where there is a broad and flat stretch of country, with stones and boulders of Permo-Carboniferous conglomerate scattered at intervals over the slate strata. A small quartz reef strikes S. 75° E., with hardly any underlay. What dip there is is to the north. A shaft has been sunk, and a little stoping has been done from the bottom. A long trench has been cut from this shaft westwards, and the reef taken out at surface. More trenches occur further west. The country at the shaft is soft slate; at the west end of the trench, seriticised sandstone. As mentioned before, this reef and the Scott and Pickett will intersect, and it might be as well to try and locate the junction on surface. In addition to the shaft on the reef, another seems to have been sunk in the country near by. Some returns have been reported as 1 dwt. per ton; others, as 6 dwts.

(*c*) *The Pride of the Hills Reef.*

Sections 170-6, 10 acres.

This reef is about a mile from the Scott and Pickett, by a north-north-east direction, and [illegible] feet above that mine. It strike[illegible] E. [illegible]. Some 9 or 10 years ago [illegible]

reef, and lower down the hill to the west an adit-level was driven on it for 51 feet. The reef in the face of the latter is 16 inches wide. The quartz is solid, white, and not well mineralised. Eighty or 90 tons of stone were broken out, and 15 tons crushed, for 15 dwts. of gold. The reef has been traced right over the hill. It would be interesting to trace the line of this reef towards the Scott and Pickett. The latter would lie as a parallel reef to the east of it.

A second reef exists near this one, and has also been sunk upon.

(d) O'Brien's Reef.

This is on Crown land, 9 chains south-west of the Scott and Pickett battery. It has been recently uncovered in the bank of the creek up the hill, opposite the battery. A small cut exposes it as a solid reef about 21 inches in width, lying between thinly foliated slate, but turning off south and cutting into the country as a flat reef. Its bearing is 15 degrees south of east, and dip southerly. The stone is hard and white, and unkindly in appearance. No gold has been recovered from it.

CONCLUSION.

The locality described in this Report is a little remote from Mathinna, but its reefs are in the same general auriferous belt. They are, in fact, at rather an extreme distance from the Mathinna axial line of folding, but it cannot positively be affirmed whether this fact operates prejudicially or not until the survey of the whole field is completed. Meantime there is no reason for ceasing to prospect, for the locality is demonstrated to have been within the range of the agencies which were concerned in the deposition of gold.

W. H. TWELVETREES,
Government Geologist.

Launceston, 13th December, 1907.

JOHN VAIL,
GOVERNMENT PRINTER, TASMANIA.

PLATE 1

LOCALITY PLAN OF REEFS

W. H. Twelvetrees
Government Geologist
December 1907.

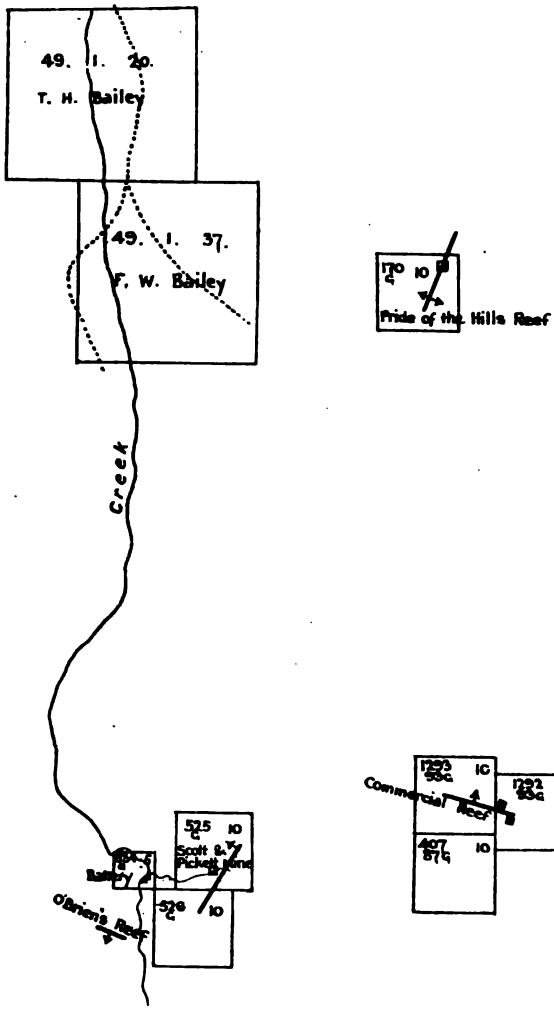


Photo-algraphed by John Vail Government Printer Hobart Tasmania
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TASMANIA

REPORT

OF THE

SECRETARY FOR MINES

FOR

YEAR ENDING DECEMBER 31

1908

Including Reports of the Inspectors of Mines, Government Geologist, Mount Cameron Water-Race Board, &c.

Tasmania:
JOHN VAIL, GOVERNMENT PRINTER, HOBART

1909

B19484

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REPORT OF THE SECRETARY FOR MINES.

Mines Department,
Hobart, 1st June, 1909.

SIR,

I HAVE the honour to submit my report upon the Mines Department and the Mining Industry for the year ending 31st December, 1908.

GENERAL REMARKS.

The aggregate value of the minerals and metals raised during the year was £1,650,027, being a decrease of £627,132 on the value of the output for the preceding year. This is principally owing to the decline in the market price of metals, for, with the exception of gold, silver-lead, and wolfram, the production of metals has increased.

The average price of tin during the year was £133 2s. 6d., as compared with £175 8s. during the previous year. It started at £124 15s. in January, receding to £123 5s. towards the end of the month, and reached its highest (£145) in April.

Silver started at 2s. 3 $\frac{5}{16}$d. in February, and gradually receded to 2s. 0 $\frac{3}{16}$d. in December; the average price being 2s. 2·316d., as compared with 2s. 6·183d. last year.

The average price of copper was £60 0s. 5·813d., as compared with £87 1s. 5$\frac{3}{4}$d. last year. The highest price (£63 10s. 8$\frac{1}{4}$d.) was reached in November, and the lowest (£57 10s. 8$\frac{1}{4}$d) in May. It will therefore be seen that the

fall in the market value of metals has seriously affected the value of the output for the year.

My attention has been drawn to the state of the tracks from Lynchford to Mts. Jukes and Darwin, and from Mts. Read and Tyndall to Lyell, and the White River Valley track (Godkin's) which are blocked with fallen timber and overgrown with scrub. They should be cleared and opened up again.

It has frequently been suggested that tracks from Howard's Plains to Zeehan, and from Harris' Reward Sections to Flannigan's Flat, would open up country which is well worth prospecting, and doubtless would receive immediate attention by prospectors if facilities were afforded them for getting their provisions and tools packed out.

Considering the importance of the mining industry to the State, and the revenue derived from the rents, dividend taxes, &c., the Department has done very little in return, either to encourage the introduction of capital for the development of mining, or to induce prospectors to go out into new country to prosecute their endeavours in search of new fields.

From time to time amounts have been placed upon the Estimates for subsidising companies to encourage them in their deep-sinking and crosscutting operations for testing the existence of reefs and lodes, and although such operations have not hitherto proved successful in establishing the existence of minerals at any great depth, it is quite possible that the barren zones have not been passed through, and the existence of reefs or lodes below 1000 feet yet remains to be proved. Last year the Zeehan-Western, Limited, Company, was subsidised upon the £ for £ principle to sink from 800 to 1000 feet, but the company was unable to secure any further assistance, and not having sufficient capital to explore at that depth, their operations had to be abandoned, and the problem of the existence or otherwise of silver-lead lodes at that depth still remains unsolved. This is to be regretted. for

the future life of the field depends upon the lodes living down, as the existing mines will soon be worked out to 500 or 600 feet, and should their lodes cease to exist below that depth they will probably be abandoned, whereas they would be encouraged to sink to greater depths if the operations at only one mine proved that below that depth a barren zone had to be passed through before recovering the lodes.

During the year, an Act to regulate the buying and selling of gold, framed upon the Victorian Act, was passed by Parliament; but it has already been proved to press very hardly upon persons working small claims under their Miners' Rights, and will require amending during the coming session.

The sale of Crown lands for agricultural purposes within mining areas, under Part V. of "The Crown Lands Act," frequently causes a great deal of trouble, and needs careful consideration, until the Act is so amended that the two industries can be carried on harmoniously in the same localities. In some districts there is plenty of first-class agricultural land on the border of known mineral land, and it is very often difficult, without a geological examination, to determine whether minerals are or are not likely to exist below the surface. I regard the reserved right to mine, as secured by "The Crown Lands Act, 1903," under Sections 67 and 68, as illusory, and not offering the freedom of action which a prospector or mineral lessee requires.

Nine miners out of ten will avoid private land, when they have to make formal application and wait until *Gazette* formalities are gone through and assessors appointed, who are to determine an amount of compensation for damage which the owner is likely to sustain, which amount must be paid to the owner before any mining is commenced on the land. This practically blocks prospecting, and it must be remembered that prospectors will not search where they are under the observation of others.

Applications for reward claims for an aggregate area of 250 acres have been lodged for the discovery of galena, copper, tin, and barytes.

Appendices.

Appended will be found the following reports and papers:—

- Annual Report of the Mt. Cameron Water-race Board.
- Report of the Government Geologist.
- Report of the Assistant Government Geologist.
- Report of the Chief Inspector of Mines.
- Reports of the Inspectors of Mines.
- Papers by W. H. Twelvetrees on the Geology of Tasmania and the Latrobe Shale Deposits.
- The Government Geologist's Report on the Lisle Goldfield.
- The Assistant Government Geologist's Report on the Mt. Farrell Mining Field.

Gold-mining.

The total quantity of gold won during the year was 57,085·124 fine ounces, valued at £242,482, being a decrease of 8259·128 ounces, and £35,126 on the previous year.

Beaconsfield.—The yield from this district was 30,127·65 fine ounces of gold. The Tasmania Gold Mine was the chief producer, having won 27,732 ounces of gold, from 71,040 tons of quartz crushed, an average of 7 dwts. 19 $\frac{42}{11}$ grs. per ton. The total quantity of gold won by the company to date is 772,890 ounces, from 757,775 tons of quartz crushed. The total amount paid in dividends is £772,671 15s. No dividends have been paid since 1905.

The following is an abstract from the company's report for the year ending 30th September, 1908:—

"At the date of the last annual report, Grubb's Shaft had reached a depth of 1277 feet, and at 1250 feet from

surface, a crosscut was being driven in the direction of Hart's, to reach the lode, which, it was anticipated, would be met with at a distance of some 360 feet. The lode was actually encountered at 335 feet from the shaft. Where struck, it was found to be split into two parts by a horse of waste rock, of a width of 16 feet, the reef itself showing on the hanging-wall 3 feet of quartz, valued at 12½ dwts., and on the footwall, 6 feet of quartz, also valued at 12½ dwts.

"Since then the level has been driven westward 177½ feet, and eastward 270 feet, a total distance of 447½ feet, 421½ feet giving an average width of reef of 7 feet, of an assay value of 12¼ dwt. of gold per ton, 'exclusive of blank ground and horses of mullock.'

"The 1100-feet level west was extended 79 feet on the lode, which averaged 6½ feet wide and 15 dwts. per ton.

"Eastward, exploratory work has been carried on beyond the fault existing in that direction, with a view to the recovery of the lode. A mineralised formation has been met with, but as yet the reef is not well defined.

"For the total length the 1100-feet level has now reached (viz., 814 feet), the average width of the lode has been 6¾ feet, and the average value 16 dwts.; the 814 feet being exclusive of the distance driven beyond the eastern fault.

"The 1000-feet level west was extended 390 feet, and for the distance of 1292 feet now driven east and west of the shaft, the assay value has averaged 19¾ dwts., over an average width of reef of 5¾ feet.

"The winzes and rises to effect communication between the bottom levels and to block out the ground for stoping, have shown, in many instances, an excellent grade of ore.

"In regard to the North Tasmania Mine (now known as the North Section), which, as mentioned 12 months ago, had been acquired by this company, the superintendent reports as follows:—

"'Work was started here in October, 1907, but before exploration could be carried out it was necessary to repair

the old underlay shaft for a distance of 109½ feet; to lengthen a winze by 6 feet for a depth of 80 feet; to carry a leading stope into the fault a distance of 100 feet; and generally to repair old workings for upcast ventilation. Air-boxes, formerly in use at the mine, were placed from the 327-feet level to the fault at the 400-feet level (a length of 260 feet), and connected to blower at surface by 18-inch diameter pipes. The drive south on fault was then cleaned out, road laid, and driving started in January, 1908. At 223 feet from the main drive the footwall part of lode was cut east of the fault, and the hanging-wall part at 248 feet; the distance driven being 153 feet. The footwall part of lode has been followed east 175 feet, in which distance two faults have been met with, which throw the lode to the south; the average width of quartz has been about 2½ feet, value from nil to a trace. The hanging-wall stone has been driven on for 60 feet; average width, 1 foot; value 3½ dwts. A small chute, not included in the average, about 8 inches wide, of rich stone was met with, assaying 27 ozs. per ton. The total distance driven on the smaller faults was 68 feet.'"

The following is a summary of the work accomplished during the 12 months:—

	feet.
Grubb's shaft	76
Crosscuts	1187
Main drives	1311
Winzes and rises	1361½
Repairs, drives, &c....	447
Mullock drives	503½

It was not found practicable to continue the sinking of Grubb's shaft beyond the 76 feet mentioned, owing to a large proportion of the output of ore being hauled through it. As soon, however, as a connection has been made at the 1250-feet level, between that shaft and Hart's, sinking will be resumed.

Hart's shaft has also been in abeyance, as it will be more economical, in order to effect a communication from the 1250-feet level, to rise against the shaft rather than to continue its sinking.

With connection between the two shafts once established at the 1250-feet level, enabling the water to be distributed between those two points, it will be practicable to continue the sinking of Grubb's shaft towards a 1500-feet level, whilst at the requisite depth, commencing a 1375-feet level, which will also be the next objective point at Hart's.

The Bonanza Company has sunk its shaft to a depth of 1180 feet.

Lefroy.—The total quantity of gold won from this field during the year was as follows:—

	oz.
New Pinafore Gold Mine	406
Creek Syndicate	422
Wilson's Syndicate	64
Kitto's Chum Syndicate...	107
G. Digney	44
Prospectors and others...	30·9
Total	1073·9

Beyond a little prospecting work nothing of any consequence is now being done upon this once flourishing field. The New Pinafore Company has not availed itself of the subsidy for deep-sinking passed by Parliament during the session of 1906. The discovery of a reef in the vicinity of the old West Chum Mine was made by Kitto and party early in the year; a small shaft was sunk 62 feet; the lode was cut and driven on some distance. East and west of the crosscut some stoping was done, and 84 tons of stone obtained and sent to Pinafore battery gave a return of 108 ounces of gold, which was considered very satisfactory. The show was then floated into a small company, a steam-winch winding-plant procured, and a shaft 10 ft. 6 in. × 3 ft. 6 in. sunk to a depth of 200 feet. The lode was cut

at two levels and driven on, but results were not satisfactory; the bottom level was disappointing both east and west. Some good stone was to be seen going east at No. 1 level, but the shoot was short, and operations were suspended and the mine closed down.

Lisle, Golconda.—About 33 prospectors were engaged during the year in working the old alluvial diggings, and they obtained 298 ounces of gold. Mr. W. H. Twelvetrees, Government Geologist, who visited and reported upon the Lisle field during the year, says:—

"The field, which was discovered by the Bessell Bros. in December, 1878, became within six months the site of the most extensive alluvial operations that Tasmania has ever witnessed; 2500 souls crowding to the valley, which was found to be clothed with dense, unpenetrated bush. After three or four years' work at high pressure, during which time an enormous quantity of alluvial gold was won, the activity slackened, and the goldwinners gradually withdrew, leaving behind but a remnant, whose numbers decreased slowly, until to-day a couple of dozen workers ply their avocation, where there were formerly a couple of thousand.

"It is difficult to state precise figures of output, because so much gold was taken or sent to Victoria without being reported to the authorities in Tasmania. Consequently figures vary between 80,000 and 300,000 ounces. The estimates which are, perhaps, most worthy of credence place the total output at 250,000 ounces, more or less. This gold has been won from a mere fractional part of the area of a valley, the whole of which does not exceed a mile and a half square in extent. The bulk of it has been sluiced from the bed and banks of the Main Creek, and from terraces sloping down to it on the eastern side of the valley; the remainder has been obtained from small creeks on the opposite side of the basin and from terraces above them.

"What has puzzled every miner and every visitor who has been confronted with the occurrences on the field is the circumstance that no reefs have been found in the valley or on the surrounding hills from which the gold may have been shed. No gold-bearing quartz has been found in the workings (beyond now and then a minute specimen), nuggets are rare, and the bulk of the creek and terrace wash consists of sandstone. The sole outlet of the valley waters is a narrow gorge at the north end, where the stream flows over a small rocky bar. The visitor, standing on the floor of the valley, finds himself in a locked basin, walled in all round by hills 800 feet to 1200 feet high, and becomes aware that, whatever may be the origin of the gold, the whole of it has been derived from some source within the area upon which he gazes. The floor of the valley is granite, which now and again has been sluiced bare, and which, concealed beneath a heavy overburden of clay and hill detritus, rises up the flanks of the hills to a height of 400 feet or 500 feet. It then junctions with sandstone or slate, in which it has intruded, and which it has profoundly metamorphosed in the way common to granite contacts. Under this influence the sandstone and slate on the eastern side of the valley appear most frequently as a siliceous, dark blue, metamorphic rock, occasionally mistaken for basalt, to which, at a cursory glance, it bears some sort of a superficial resemblance. In places it is a reddish brown, highly micaceous sandstone, becoming argillaceous during decomposition. On the west side of the valley there is much less of the bluish quartzite. In some places this metamorphic rock has been originally a slate. The junction of the granite with the metamorphic rock is always hidden beneath the covering of clay and detritus which clothes the hill slopes. In one instance, however, it has been reached by tunnelling, viz., in C. Bessell's tunnel, on the western hill slope. There the contact was marked by a vein of chalcedony. I have consequently scrutinised closely the nature of the stones with which the gold is

associated in the alluvial workings, in order to see whether any useful information may be gained from them.

"1. First, an absence of stones of granite may be noticed. These are rare. The granite bottom is always soft, hence no stones could well be released from it.

"2. Stones of chalcedony (sometimes carrying disseminated pyrite) are common. These have probably proceeded from veins in the granite and from the contact-line.

"3. Stones of the blue metamorphosed sandstone are the most frequent. These have the habit of weathering to an external crust, until at last very often a small kernel of the fresh rock remains in the centre. The miners call this becoming coated with sandstone.

"4. Stones of the reddish brown micaceous sandstone are also common in the wash. These weather until they are completely disintegrated.

"5. Locally, there are large stones of white barren quartz in the wash of detritus. The veins from which they have proceeded have not been found. Such veins have not been noticed in the soft granite bottom anywhere; nor have they been discovered outcropping in the sandstone rock, though it is surmised that that is their home.

"The creek workings have yielded the most gold; the terraces, rich in patches, have given only a fraction of the total output. In the terraces a few feet of clayey bottom wash have contained the best gold; the upper part, consisting of hill detritus and subangular drift, has generally been non-payable, though carrying gold. On the slopes of the hills gold has been found in the very grass. Here and there are signs of the terrace drift having accumulated on a lake shore, but there is no proof that the lake filled the entire basin at any one time.

"Practical miners, with experience gained on the mainland, and experts, have visited the field from time to time, but have gone away baffled and mystified. Recourse has even been had to a theory that the gold has been carried here from reefs on the other side of the Patersonia Divide.

But if there is anything which stands out more clearly than another, it is that all this gold never proceeded from ordinary quartz reefs. If it had, specimens of gold quartz would have been fairly abundant. The absence, or more strictly speaking, rarity, of specimens absolutely precludes the idea that the gold was a constituent of quartz reefs. We seem, therefore, shut up to the idea that the gold was derived (1) either from soft seams in the granite (*e.g.*, of mica or kaolin), or (2) from chalcedony veins at the contact of the granite and sandstone, or (3) from impregnations of the sandstone near the granite contact. No gold has ever been seen in the stones of chalcedony, so there is no evidence that can be appealed to in favour of a chalcedonic source, beyond the fact that I was able to detect pyrite in some of the stones. Apart from this the source of supply would be too limited.

"As for the idea, which I suggest, that some gold may have been released from joints or veins in the granite filled with or composed of micaceous material, I think this may very possibly have been the case, but the proof is difficult.

"With regard to the final suggestion which I advance, I consider it as the solution of the problem. The sandstone near its contact with the granite has on this hypothesis been saturated with silica from the cooling granite, and this gold-bearing siliceous solution permeating the porous rock has deposited its metallic freight in the interstices of the sandstone. The gradual weathering of the rock has liberated the gold, which, together with the sandstone detritus and wash, has found its way down hill to the terraces and creek alluvial. I cannot quote any parallel occurrence, but all the facts and features of this field are in harmony with this view. The pieces of sandstone with crustal weathering are looked upon locally as characteristically the associates of gold; and on this supposition we can readily see why they are.

"Finally, I have detected visible free gold in the dark-bluish sandstone referred to above. One of the rock

specimens which I brought home, on being broken, showed distinct specks of gold free from quartz or pyrite. It is true that I have only been able to observe this in a single specimen, and I have broken hundreds of other samples: but one solid fact outweighs numberless negative results. It may therefore be accepted as an undoubted fact that gold is present in the sandstone, and I have no doubt that the bulk of the Lisle alluvial gold has been derived from the wasting away of the impregnated stratified rock near its contact with the granite. This impregnation may be irregular, and in any case it will not be easy to find the metalliferous patches, and even when found they will not necessarily prove payable. But if it is considered desirable to carry out tests, the first thing to do is to remove the overburden, and lay bare the bed-rock at the contact. It may be that patches of it will be found rich enough to work. The contact line from Donnelly's to behind Bessell's suggests itself as the most likely locality for such work.

"The gold-bearing specimen may be seen at my office by anyone interested in the matter.

"A good deal of alluvial ground in the western part of the valley remains to be worked, and some of this is to be taken in hand directly by the new company lately registered in England.

Mt. Victoria.—One hundred and nine ounces of gold were obtained from quartz, about half a dozen men being employed.

The New River Freehold Mine resumed work in the early part of the year, but operations ceased after a few months' work. Want of capital is the reason assigned for this. It seems a pity that the lode on this company's property has not received a trial at a greater depth, there being, it is stated, a fairly good body of stone carrying gold (ounce stone in places). It has only been tested to a depth of 200 feet.

The New Ringarooma Syndicate is still working with two or three men.

Mathinna.— During the year ending 31st January, 1909, 1903 tons of quartz have been crushed by the New Golden Gate Mine, and 1154 ounces of retorted gold have been obtained at the battery, and 142 ounces of bullion from cyanide plant, valued at £4104 15s. 6d. From this, also, $9\frac{3}{4}$ tons of pyrites were obtained by concentrating tables, containing 208 ounces of gold, valued at £607 6s. 6d., which, together with rental of cyanide plant (£76 11s. 3d.) and charge for crushing a parcel of quartz from outside sources (£5), also interest on fixed deposit (£46 4s. 11d.), made a total revenue of £4839 18s. 2d. The cost of raising and crushing quartz, treating concentrates, tailings and slimes, repairs and renewals to plant, progressive and surface works, and all other expenses incidental to working the mine and managing the company, amounts to £4507 9s. 1d., or £2064 16s. 11d. in excess of revenue obtained from the mine.

The total quantity of quartz now obtained from the mine is 273,251 tons, which has yielded 228,990 ounces of gold an average of 16 dwts. 18·21 grs. per ton, and which has realised £870,513 18s. 10d. The total amount paid in dividends is £355,200, or £11 2s. per share; and the total amount paid for dividend tax is £16,638 10s.

The Golden Horseshoe Company has taken up some sections at Dan's Rivulet, near Mathinna, and is actively prospecting them.

The Tasmanian Consols Mine obtained 2459 ounces of gold. The mine has now closed down, the last of the payable stone having been taken out.

The Miner's Dream and Scott and Pickett Mines were closed down towards the end of the year.

The Briseis and North Brothers' Home Tin Mining Companies at Derby obtained 57 and 39·84 ounces of gold respectively from their tin drifts; the South Mt.

Cameron Tin Mining Company, 78·30 ounces; and the Ringarooma, Dorset, and Gladstone Bucket Dredges, on the Ringarooma River, obtained respectively 3769·90 and 41·35 ounces.

Gladstone.—Some work has been proceeding at two points near the Gladstone township, viz., (1) a little north of the old Royal Tasman, by the Dreadnought Gold Mining Syndicate; and (2) at O'Halloran's and Saville's discovery, by the Gladstone Gold Prospecting Association.

(1) Dreadnought Gold Mining Syndicate.—The reef crops out at surface near the old Tasman shaft, and a cut has been put into it showing the stone to be, roughly, east and west. A little stone has been got, and the reef channel proved to be about 4 feet wide; but in the cut it has apparently narrowed somewhat. Below is the North Tasman tunnel, which was driven upwards of 300 feet in a northerly direction, with drives at the end both east and west, but now fallen in.

At present nothing much can be seen of the lode underground, but the stone has apparently come down to this level. The old hands say that the reef-channel was about 8 feet wide, of which 4 feet consisted of a horse of mullock. What stone is visible is mottled and kindly looking, but nothing definite can be learned as to the occurrence before the old drives are cleared out. The reef seems to be a parallel one with the Royal Tasman reef. The latter was expected to be cut in the tunnel, but has not been seen. Some rich samples are stated to have been taken.

(2) Gladstone Gold Prospecting Association.—The ground on which operations are proceeding is across the creek, opposite the Dreadnought. Here, too, a parallel reef is being worked upon. A north and south reef, with stone 6 to 10 inches wide, has been opened upon, and good assays stated to have been obtained. I saw that free gold occurred in the stone. A hundred feet north from the open-cut the reef is intersected by another, which also

yields good prospects, with good gold also in the rubble. A shaft is being sunk near the intersection to test the reef in depth.

If these reefs at Gladstone can be shown to be worth development—and they certainly seem worth proving—good work will have been done.

The occurrence of this gold tends to confirm the old Royal Tasman discovery, which at the time received scant credence, but which, perhaps, after all, deserved better treatment.

West Coast.—The quantity of gold won from alluvial workings was only 24½ ounces.

Towards the close of the year, Mr. W. Davie, of Lynchford, discovered a gossanous gold-bearing formation at the head of the Mt. Lyell Company's tramway-line, about 4 miles from Lynchford, from which some good prospects are said to have been obtained.

On the opposite side of the valley to the gossanous outcrop, Mr. Davie discovered a small quartz reef outcropping on the surface, and is putting in a tunnel to cut the reef 30 or 40 feet below.

The land has since been taken up under lease by the Davie Prospecting Syndicate.

When at Queenstown in March last, I visited the ground, and took a sample of the gossan and had it assayed by the Government Analyst. It gave 6 dwts. 12 grs. of gold and 1 dwt. of silver.

Silver-lead Mining.

The quantity of silver-lead ore produced was 63,116·92 tons, valued at £322,007, being a decrease in quantity and value of 26,645·64 tons and £250,553.

The decrease is principally owing to the temporary stoppage of the Tasmanian Smelting Company's works in April, followed by the temporary closing down of the Magnet and Hercules Mines.

The principal producers were:—

	Tons.	Value. £
Mt. Zeehan.		
Mt. Zeehan (Tas.) Company	4422	51,910
Zeehan-Montana Mine	3572·63	46,456
Zeehan-Western, Limited	1054·17	8413
Zeehan-Queen Mine	234	813
Silver Queen Extended Mine	514·75	2115
Oonah Mine	4553	10,064
Silver King Company	93	797
Florence Company	2809	31,989
Watt's Section	60·76	621
Austral Valley Company	276·58	1204
Zeehan Bell Company	94·30	744
Section 1064-M	63	478
Victoria-Zeehan Mine	29·25	271
Tasmanian Smelting Company (Balstrup's)	1590	1703
Sylvester Company	50·50	262
New Mt. Zeehan Company	589·37	1076
Colonel North Company	320·47	968
Section 1816-M	67·06	292
Section 1914	20·30	205
T.L.E.	30·21	122
Section 1846	15·75	151
Nubeena Mine	72·90	860
South Comstock Company	22	242
Mt. Dundas.		
Comet Company	8327·11	5116
West Comet Company	2211·35	1171
Hercules Company	12,964	51,447
Adelaide Company	50·74	655
Anderson's	20	255
Rosebery.		
Primrose Company	1649	6034
Tasmanian Copper Company	7610·71	25,245
Mt. Farrell.		
North Mt. Farrell Company	3825	31,796
Mt. Farrell Company	196·85	706
Murchison River Company	279·75	4545
Macintosh Mine	88	1122

Zeehan District.—This district has experienced a period of great depression, owing to the low price of metals, the temporary closing down of the Tasmanian Smelting Works, followed by the fiasco at the Colebrook smelters, and the temporary closing down of the Hercules Mine. A large body of men were thereby thrown out of employment, many of whom left the district, while others who had their homes and families at Zeehan were unable to leave. Such a period of depression cannot possibly be realised by those who have not actually experienced it. Business was at a standstill; tradespeople became alarmed; and a deputation was sent to Hobart to interview the Premier and ask him to consider the position and give some help to keep the place going, as the loss to the State in that way would be less than if the smelters were allowed to close down permanently. The position was saved by the Government making certain freight concessions to the Tasmanian Smelting Company, and by passing a Bill authorising a loan of £20,000 to the company.

The Zeehan-Western, Limited, has sunk its shaft a further depth of 200 feet, and is now down 1000 feet, having been subsidised by the Government to the extent of £3000 upon the expenditure of an equal amount by the company. The company has applied for a further sum to enable it to drive at the 1000-feet level to ascertain if the the lode, which existed at the shallower levels, continues down. This shaft is the deepest on the field, and it would be a great pity to allow it to be closed down when the expenditure of a comparatively small sum of money would determine whether or not the lodes on the Zeehan field exist at a depth.

The Mt. Zeehan (Tas.) Mine and the Zeehan-Montana Mines continue to be the largest producers on the field.

Florence Mine.—During the latter part of the year the mine became flooded at the bottom level through striking a heavy flow of water, and operations had to be confined to the lodes above water-level, the boiler-power not being

sufficient to contend with the water. This, added to the stoppage of the smelters, caused the output from the mines to be very considerably restricted.

Dundas District.—The Comet and West Comet and Adelaide Mines were the only mines at work during the year. The latter company, during the last quarter, confined its operations to driving the No. 3 level (320 feet), which was extended 142 feet; total, 501 feet. The shaft was sunk 35 feet; total, 89 feet below No. 3 level. At 50 feet below No. 3 level the lode was exposed, 7 feet wide, with 18 inches to 2 feet of galena.

Mt. Read District.—Hercules Mine.—This mine suspended operations temporarily on the 15th May, owing to the closing down of the Tasmanian Smelting Company's works and the difficulty of getting at the zinc-blende ore in the mine, caused through a subsidence. The company resumed operations again early in July, and has been working continuously since.

Rosebery District.—The Tasmanian Copper Company has been opening up its zinc-lead sulphide mine.

The Tri-metallic Company has taken up a large area of ground for the purpose of erecting smelters for treating the complex ores in this locality by a new process, in the hope of recovering a large proportion of the zinc, in addition to the usual yield of silver and lead.

The Colebrook Company completed its smelting plant, but was compelled to close down after a very short run, owing to the grade of the ore mined and the low price of copper.

Mt. Farrell District.—The North Mt. Farrell Company has maintained a steady output, averaging 318 tons of galena ore per week. The old wooden tramway line from the mine to Rosebery has been replaced by a steel tramline junctioning with the Emu Bay line at Boko Siding.

The Mt. Farrell, Mackintosh, and Murchison River Companies raised respectively 196, 88, and 279 tons of ore.

North-Western District.—**The Magnet Silver Mine produced 5170·28 tons of ore, valued at £30,349. The output from the mine was restricted owing to a strike, which occurred in the early part of the year.**

Long Tunnel, Mt. Stewart.— **Forty-four tons of ore were raised, valued at £581; six men being employed.**

Northern and Southern District.—**The Devon Mine raised 60 tons of ore, valued at £870, employing seven men.**

The Round Hill Mine raised 65 tons of ore, valued at £360; seven men employed.

Copper-mining.

The total quantity of blister copper and copper ore produced was 10,018·15 tons, valued at £609,651; being an increase of £982·90 tons on the previous year's output.

The output of the Mt. Lyell Mining and Railway Company, Limited, has been steadily maintained, the mine having produced 8833 tons of blister copper, containing 8722 tons of copper, valued at £533,026 8s. 5d.; 689,985 ounces of silver, valued at £70,035 13s. 11d.; 18,355 ounces of gold, valued at £78,008 15s.— **a total value of £681,070 17s. 4d.; being a decrease of £233,496 10s. on the previous year. The amount paid in dividends was £210,000.**

Prospecting has been chiefly centred in the Mt. Lyell Company's group of mines—to the North Lyell section—where satisfactory progress has followed their labours. Sinking in both shafts has been kept well ahead of each succeeding level. The landing chambers, or braces, of each shaft are underground and on different levels, but the sumps of both total the same depth from the surface, viz., 1110 feet, where chambers, the necessary crosscuts for

prospecting, ventilation, and other purposes, are being prosecuted.

Developments in keeping with the values on the higher levels have been firmly established in the Nos. 23 and 24 stopes of the 1000-feet level. The lastmentioned stope is situated about 250 feet north-east of the main shaft, where, in a southerly direction for a length of 170 feet, rich bornite has been carried through and still continues in the face. Beyond these works this level is practically intact, and with that of the 850-feet, whose stopes 18, 19, and 20 are still really on the ground-floor, may safely be said to comprise the reserve stores of the mine. To facilitate despatch an electric winding hoist, capable of raising 30 tons per hour, together with a compressor of 2400 cubic feet of free-air capacity, have been erected and placed in commission.

At the Iron Blow extractions continue apace, the depletion of the pyrites up to the No. IV. bench being now almost accomplished, while that of the last, or No. 5, is already commenced. Between these sub-benches, A, B, and C benches intervene; and the last official records state those remaining will produce some 700,000 tons more of this class of ore, after which underground mining will, in all probability, be resorted to.

Next to the Mt. Lyell Company, the more persistent investigators have been the Crown Lyell Extended Proprietary, who have devoted much time and capital to the development of their property, which is situated in the valley between Mts. Lyell and Sedgwick. At present a substantial 2-ft. wooden tramway is being laid down to connect the mine with a like gauge on the Mt. Lyell Company's service, which, when completed, will permit of consignments of copper-zinc and silver-lead ores being prepared and made marketable for outside competition.

The Comstock Copper Mine adjoins the foregoing property, and has had several of its adits extended and other-

wise prospected by means of a portable diamond-drilling plant driven by an oil-engine.

The Blocks, Consols, Crown Lyell, and Copper Mines of the Mt. Lyell West have been practically idle throughout the year.

At the Lyell Extended a prospecting shaft has been sank 50 feet, and at this depth driven a like distance on exceptionally rich copper clays that are still receiving attention.

Darwin.—The Thompson P.A. and Darwin Syndicate have each done serviceable work on their respective properties, and bulk samples from the latter were treated at the Mt. Lyell Company's works, and gave satisfactory results.

The Jukes Proprietary, Lake Jukes, Hydes' show, and other sections remain idle, but there is very little doubt, with the prospects present in all of these cases, further trials will hereafter be allotted to each and all of them.

Mt. Balfour.—This is a new copper field, and is attracting a considerable amount of attention. A geological survey inspection of the field will shortly be made by the Assistant Government Geologist.

From the 1st February, 1907, to the 31st December, 1908, the Murray Bros. raised 501 tons of copper ore, valued at £6289, and shipped it to New South Wales.

The Mt. Lyell Mining and Railway Company has taken up a number of sections on the Norfolk Range, and is systematically prospecting them, with very encouraging results.

Tin-mining.

The quantity of tin ore raised was 4520·80 tons, valued at £421,580, an average of £93 5s. 1d.

This shows an increase of 177·80 tons on the previous year.

The statistics for the year were:—

	Ore won.	Miners employed.	
	tons.	European.	Chinese.
Northern and Southern Division	89·95	33	—
North-Eastern Division ...	2857·15	696	61
Eastern Division	331·60	256	33
North-Western Division...	1107·19	402	—
Western Division...	134·91	103	—
	4520·80	1490	94

Considering the very dry summer, when many of the mines were idle for want of water, the output is very satisfactory.

Northern and Southern Division.—The only mine working in this Division during the year was the Shepherd and Murphy Mine, near Middlesex; 89·95 tons of tin ore were obtained, and 33 men employed.

North-Eastern Division.—The Briseis Tin Mines, Limited, has been the largest producer, with 1046·73 tons, and has distributed in dividends £60,000. In addition to its original property, the company is engaged in removing the overburden from the section formerly held by the New Ringarooma Tin Mining Company. The New Brothers Home Mine, which adjoins the Briseis Mine, is being worked by the latter company. It has produced 340·73 tons of tin ore, and has paid £12,000 in dividends.

The Arba Tin Mining Company raised 118·95 tons of ore.

The Pioneer Tin Mine raised 446 tons of ore, and paid £15,965 in dividends. This company has constructed a large dam on the Frome River for providing water-power for generating electricity for the electric plants, and water for sluicing purposes. The dam is 625 feet long, and 54

feet deep, and its capacity is 420,000,000 gallons of water up to the 51-feet level.

The Gladstone Tin Mines suffered considerably owing to the very dry summer. The principal producers were:—

	Tons.
South Mt. Cameron Company	95·65
Purdue Tin Mine	87·05
Dorset Bucket Dredge	61·55
Ringarooma Bucket Dredge	53·30
Argus Mine	40·05
Garibaldi Company	28·25
Gladstone Bucket Dredge	16·8
New Aberfoyle Company	8·95
Mussel Roe Company	7·55
Scotia Mine	6·70

Eastern Mining Division.—The Anchor Tin Mine raised 129·68 tons of ore, employing an average of 95 men. During part of the last quarter the mine was idle owing to the drought. The company has entered into an agreement with the Australian Tin Mining Company to work its property on the Blue Tier, in conjunction with its own, and to connect the properties by an aerial ropeway.

The alluvial tin mines have contributed rather less than their usual output, having been considerably hampered by the want of water for sluicing purposes.

Western Mining Division.—Heemskirk.—Very little tin has been raised from this field.

The Federation Tin Mine has been prospecting, and has obtained some very encouraging results. Interest seems to be reviving in some portions of the district, and small parties are obtaining a little tin under miners' rights.

North-East Dundas.—Renison Bell Tin Mine.—The work done during the year was mainly upon the hill slope above the Emu Bay Railway-line. Sluicing the decomposed lode-capping, from which marketable ore has been won,

was continued for a considerable portion of the year during the period water was obtainable. The total sales of this detrital ore have now reached about £6000 since sluicing was started. As work proceeded up the hill the material became much harder and deeper, frequently requiring blasting out; but the larger portion after water had been brought upon it by nozzle became friable and easily broken up. This was then run through the sluice-boxes and dressed for market. While treating this ore for sluicing a large quantity of quartz of various sides was uncovered, some blocks being several tons weight; this has been stacked for crushing by battery. It is estimated that there are fully 1000 tons of this high-grade ore at this spot uncovered. Some 2 tons of stone, which will assay 50 per cent. tin, were also obtained from here. The company have now purchased a first-class battery and dressing-plant, and are erecting it close to the Emu Bay Railway-line. A self-acting tram from the Blow, and two branch trams to connect with it to convey ore to battery, are about to be constructed.

The other mines in this district are being prospected, and some very rich deposits have been discovered; and the district promises to add very materially to the tin output of the State in the future.

The Assistant Government Geologist has been spending some time on the field, and has prepared a very extensive report upon the tin ore-deposits.

North-Western Mining Division.—The Mt. Bischoff Tin Mining Company has raised 930 tons of tin ore, and has paid a sum of £36,000 in dividends. The total quantity of tin ore produced by this company is 67,493 tons, and the total amount paid in dividends is £2,160,000.

The Mt. Bischoff Extended Company has erected its 10-head battery, boiler, and engine, and has raised 125·35 tons of ore. A new lode in the bottom level was discovered, giving good value in tin oxide.

The Waratah Alluvial Company has raised 14·60 tons of ore, employing 5 men.

Whyte River.—The Mt. Cleveland Company has erected a 10-head battery and concentrating plant, capable of treating 1000 tons of ore per month. The battery was started in September, and during the last quarter of the year 22 tons of tin ore were obtained.

Coal-mining.

The total quantity of coal raised amounted to 61,067·75 tons, valued at £51,907; being an increase of 2156·75 tons on the previous year.

The raisings at the different collieries were:—

Colliery.	Tons.	Average number of men employed.
Cornwall	37,098	84
Mt. Nicholas	18,441	60
Tasmanian Wallsend... ...	2499·75	20
Mt. Cygnet	1333	2
Spreyton...	851	5
York Plains...	652	2
Woodbridge...	110	2
Illamatha	60	2
Jubilee	23	3
	61,067·75	180

The principal producers have been the Cornwall and Mt. Nicholas Coal Mines. The output of the former company shows a considerable increase on the previous year, while that of the latter company shows a decrease.

The Sandfly Colliery has changed hands during the year, and is now held by the Tasmanian Wallsend Colliery Company. Mr. R. H. Stokes, late of the Stockton Colliery, New South Wales, is in charge, and the mine is being opened up in a very systematic manner under his management.

Iron Ore.

The quantity of ore mined by the Tasmanian Iron Mines at Penguin was 3600 tons, valued at £1600; 12 men employed.

This was the only mine at work during the year.

Wolfram Ore.

The output of wolfram ore was as follows:—

	Tons.	Value. £
Shepherd and Murphy Mine, Middlesex	0·90	62
Ben Lomond Mines	3·93	276
	4·83	£338

Bismuth.

The Shepherd and Murphy Mine at Middlesex obtained 3·75 tons of bismuth from its tin ore, valued at £462.

Scheelite.

This mineral has been discovered on the south coast of King Island, on a reward claim taken up in the names of A. T. Winterbottom and M. Parer. The lode is stated to be from 12 to 20 feet wide, the walls well defined, and there are 200 feet of backs. There is a plentiful supply of wood and water, and a good shipping port within half a mile. The lode is said to carry, in addition to sheelite, considerable quantities of molybdenum, bismuth, and tantalum. A bulk assay of the ore, made at the British Flag Company's plant on the Fraser River, has proved that 80 per cent. of the ore-contents can be saved in treatment.

Barytes.

The presence of this mineral in appreciable quantities has been brought into prominence by Mr. W. H. Taylour,

who is engaged opening up a clean reef or deposit on a north-eastern flank of Mt. Darwin, from where he has obtained extensive bulk samples that have merited the approval of intercolonial investors who are at present interested in the property.

From American files it is gathered that some 89,000 crude tons of barytes were disposed of some 12 months ago for, approximately, 277,000 dollars.

On Howard's Plains, within a mile of the Mt. Lyell Company's Office, Mr. W. H. Wesley has obtained a reward section for this mineral. It is stated to be a large and very rich deposit.

Slate.

A deposit of slate of good quality has been discovered on King Island. This is now owned by a company having a working capital of £3500.

Bucket-dredging.

The only bucket-dredges in the State are those engaged dredging for tin on the Ringarooma River.

The Dorset Bucket-dredging Company, No Liability.—This company obtained 65·55 tons of tin ore and 58·95 ounces of gold; 20 men employed.

Ringarooma Bucket-dredging Company, No Liability.—53·30 tons of tin ore and 89·90 ounces of gold were obtained; and 17 men employed.

The Gladstone Tin Development Company, No Liability.—16·80 tons of tin ore, and 28·40 ounces of gold were obtained during the first half of the year; 16 men employed. The paddock having been worked out,

the company has been waiting for a flood to enable them to remove the pontoon lower down the river.

THE following Return shows the Quantity and Value of Mineral Products for the State of Tasmania during the Year ending 31st December, 1908.

Mineral.	Quantity.	Value.
		£
Gold * ..... ozs.	57,085·124	242,482
Silver-lead Ore ..... tons	63,116·92	322,007
Blister Copper † ..... „	8833	603,063
Copper and Copper Ore... „	1185·15	6588
Tin Ore..... „	4520·80	421,580
Iron Ore ..... „	3600	1600
Coal ..... „	61,067·75	51,907
Wolfram ..... „	4·58	338
Bismuth ..... „	3·75	462
Total	...	£1,650,027

* Fine gold, including gold contained in blister copper and silver-lead bullion.

† Value of gold deducted.

Geological and Mineralogical.

During the year the Government Geologist has examined and prepared reports on the goldfields of Lisle and Cradle Creek, the Gunn's Plains and Alma mineral districts, North-West Coast; and the Assistant Government Geologist has prepared a report on the Mt. Farrell mining

field, and made a geological examination of the North Dundas tinfield, and at the close of the year was engaged in preparing his report thereon.

Special attention has been devoted to the production of improved geological bulletins. In this respect the method of procedure adopted, and the material which is presented, will, it is believed, prove of permanent value and assistance to the mining industry. Maps are being issued with each publication, which represent the geologic structure of each district examined, with a certain degree of finality, and questions of tectonic geology, lode-structure, and vein-types, are discussed and treated in a way which aims at exhibiting the intimate connection existing between general and economic geology, and stating and elucidating numerous problems and facts connected with the deposition and occurrence of ores. The results are not only useful at the present time, but will be of value also in the future as the development of the mining fields proceeds.

It is satisfactory to be able to note that the survey has been successful in accomplishing economic work which is of admitted benefit to the mining community. It commends itself as good policy, as far as finances permit, to foster and develop this growing and useful branch.

During the year the geologists took charge of exploring parties from Tyenna to the Gordon and from the Linda Track down Jane River towards the Gordon, and their reports and maps of these areas will be in the annual report of the Surveyor-General. Nothing was discovered on these journeys to encourage the hope that any mining fields of first-class importance will come into being, though naturally the observations made were confined to the country in the immediate vicinity to the route followed, and in an area so extended unsuspected indications may still lurk unseen.

This track may possibly, in the future, develop into a through route to the Gordon to Macquarie Harbour.

Inspectors of Mines.

The three inspectors have satisfactorily discharged their duties in the districts severally allotted to them. Their reports are appended.

Mining Managers' Examination.

The annual examination of candidates for mining managers' certificates was held in March. One candidate presented himself for examination, and succeeded in obtaining a first-class certificate.

Diamond-drills.

No. 1 diamond-drill was engaged by Messrs. Otto and Eiszele from the 3rd to 27th June, to bore for coal on their private property at Sorell Creek. Their efforts were unsuccessful. One bore only was put down 218 feet 2 inches.

Mt. Cameron Water-race Board.

The report of the Board is appended.

Departmental Staff.

The only changes which took place in the staff during the year were the appointment of Edward Henry Fowell as temporary Registrar of Mines at St. Helens, *vice* A. D. Soutar, resigned; P. J. E. Grant, Registrar of Mines, Waratah, *vice* J. Lonergan, removed; and the transfer of E. Rule.

Revenue.

The net revenue for the year amounted to £20,311 3s., being a decrease of £4483 4s. 7d. on the previous year. This amount does not include the sum of £2454 7s. 11d. deposited as survey fees with applications for leases.

Conclusion.

In conclusion, I desire to thank officers of the Departmental staff for the loyal and efficient manner in which they have performed the duties allotted to them.

I have, &c.,

W. H WALLACE, Secretary for Mines.

The Hon. Donald Campbell Urquhart,
Minister for Mines.

DIAMOND-DRILLS.

Statement of Work done to 31st December, 1908.

Year.	Locality.	Direction of Bore.	No. of Bores.	Total Distance Bored.	Average cost per foot, inclusive of Labour and Fuel.
	No. 1 Drill.			feet.	£ s. d.
1882-3	Back Creek—For Gold	Vertical	7	1330	0 10 9
1883	Lefroy—For Gold	Ditto	4	1011	0 5 3
1884	Tarleton—For Coal	Ditto	1	401	0 5 6
1886	Longford—For Coal	Ditto	2	1585	0 4 0½
1886-7	Harefield Estate—For Coal	Ditto	1	725	0 6 5
1887	Cardiff Claim, Mount Malcolm—For Coal	Ditto	1	562	0 17 11¾
1888	Killymoon Estate—For Coal	Ditto	1	504	0 4 7¾
1888-9	Seymour—For Coal	Ditto	5	2266	0 7 8½
1889 / 1890	Beaconsfield (Phœnix G.M. Co.) For Gold	Ditto	1	781	2 0 2
1890	Beaconsfield (East Tasmania G.M. Co.)—For Gold	Ditto	1	978	0 14 9½
1891	Spring Bay—For Coal	Ditto	4	937	0 6 10
1891	Ravensdale—For Coal	Ditto	1	114	0 11 1½
1891-2	Back River, Prosser's Plains—For Coal	Ditto	2	854	0 6 1¾
1892-3	Lefroy (Deep Lead Syndicate)—For Gold	Ditto	4	979	0 15 9
1893	Lefroy (East Pinafore Co.)—For Gold	Ditto	1	317	0 10 3
1895-6	Sandfly—For Coal	Ditto	4	2130	0 11 5
1898 / 1900	Blue Tier (Anchor Co.)—For Tin	Ditto	9	876½	0 9 1¾
1901-2	Llandaff—For Coal	Ditto	3	1044	0 7 4
1902	Recherche (Catamaran Co.)—For Coal	Ditto	2	956	0 9 3
1903	Ditto (Moss Glen Co.)—For Coal	Ditto	2	667	0 7 6
1908	Sorell Creek, New Norfolk—For Coal	Ditto	1	218	Not obtainable
	Total	...	57	20,135½	

	No. 2 Drill.				
1882	Beaconsfield—For Gold	Horizontal, underground	1	68	No record
1883	Mangana—For Gold	Ditto	1	546	0 15 1
1884	Guy Fawkes Gully, near Hobart For Coal.....	Vertical	1	612	0 5 6
1885	Malahide Estate, near Fingal— For Gold	Ditto	5	1397	0 5 6
1886	Carr Villa, near Launceston For Coal	Ditto	1	571	0 5 4
1886-7	Waratah (Mount Bischoff Alluvial T.M. Co.) For Tin	Ditto	7	1548	0 6 1½
1887	Waratah (Mount Bischoff T.M. Co.)—For Tin	Ditto	7	841	0 11 8
1887	Ditto	Horizontal, underground	1	53	0 7 8
1888	Old Beach— For Coal	Vertical	1	593	Abt. 0 10 9
1888	Campania—For Coal	Ditto	1	600	0 7 7½
1888	Richmond—For Coal	Ditto	1	500	0 5 1½
1889	Back Creek—For Gold	Ditto	4	787	0 8 5½
1891	Macquarie Plains For Coal.....	Ditto	2	989	0 4 5½
1891	Jerusalem—For Coal	Ditto	1	344	0 4 9½
1892	Langloh Park For Coal	Ditto	4	1249	0 5 3½
1893	Southport—For Coal	Ditto	1	612	0 5 3
1894	Zeehan (Tasmania Crown S.M. Co.)—For Silver ...	Horizontal, underground	2	319	1 0 2½
1902	Eden—For Coal	Vertical	2	566	1 0 7½
1902-3	Farm Cove—For Coal	Ditto	1	571	0 5 6
	Total.....	...	44	12,766	

Aggregate number of bores 101
Total distance bored .. .. 32,901½ feet

W. H. WALLACE, Secretary for Mines.

No. 1.

RETURN showing the Quantity and Value of Gold won during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900. 1901, 1902, 1903, 1904, 1905, 1906, 1907, *and* 1908.

Year.	Quantity.		Value.
	ozs.	dwts.	£
1880	52,595	0	201,297
1881	56,693	0	216,901
1882	49,122	6	187,337
1883	46.577	10	176,442
1884	42,339	19	160,404
1885	41,240	19	155,309
1886	31,014	10	117,250
1887	42,609	3	158,533
1888	39,610	19	147,154
1889	32,332	13	119,703
1890	20,510	0	75,888
1891	38.789	0	145,459
1892	42,378	0	158,917
1893	37,687	0	141,326
1894	57,873	0	217,024
1895	54,964	0	206,115
1896	62,591	0	237,574
1897	77,131	0	296,660
1898	74,233	0	291,496
1899	83,992	0	327,545
1900	81,175	0	316,220
1901	*69,491	0	295,176
1902	*70,996	0	301,573
1903	*59,891	0	254,403
1904	*65,921	0	280,015
1905	*73,540	10	312,380
1906	*60,023	8	254,963
1907	*65,354	5	277,607
1908	*57,085	2	242,482
	1,587,761	4	6,273,153

* Fine Gold.

Diagram showing Total Quantity & Value of Gold won in Tasmania during the years 1880-1908

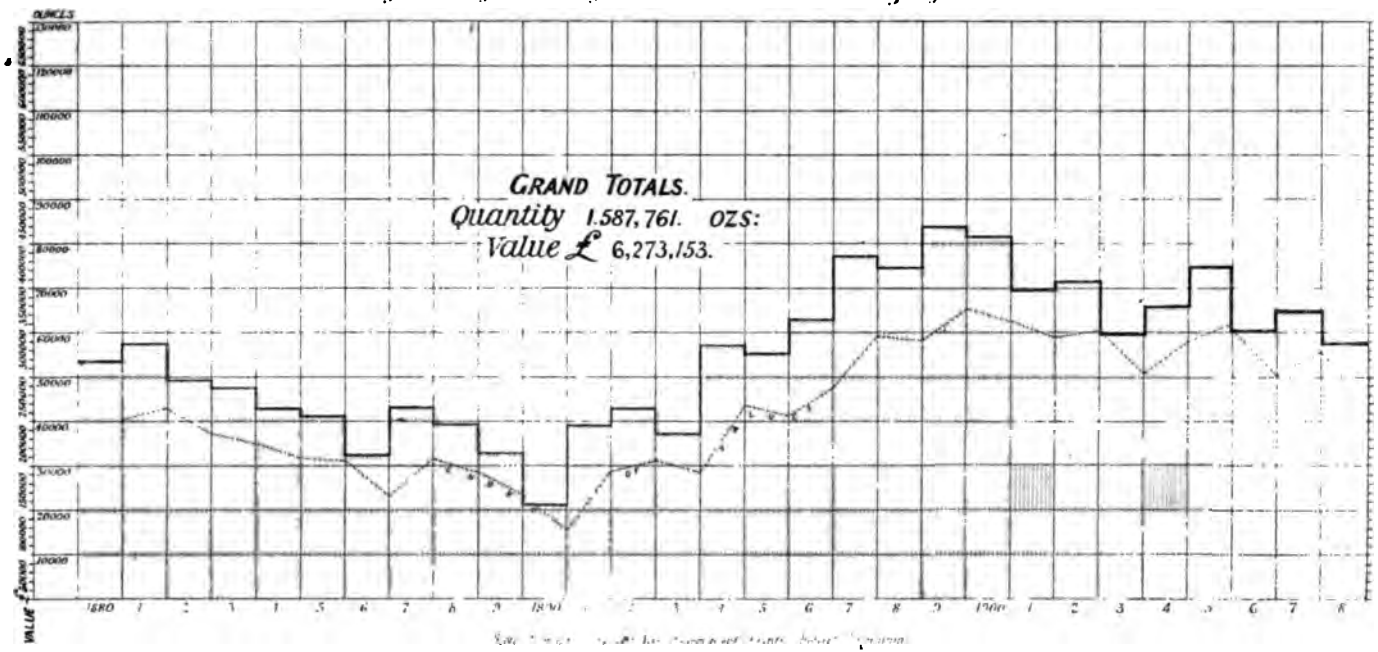


Diagram showing Total Quantity & Value of Coal raised in Tasmania during the years 1880-1908

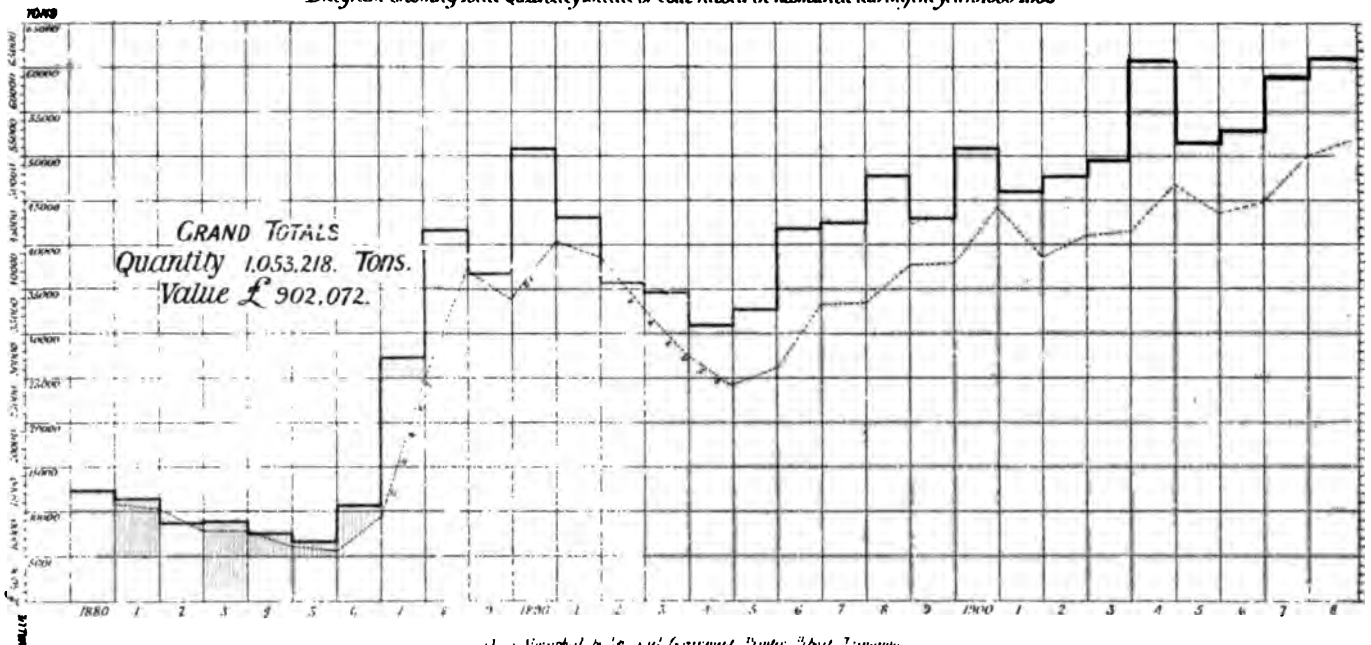


Photo-lithographed by the Government Printer, Hobart, Tasmania.

No. 2.

RETURN showing the Quantity and Value of Coal raised during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, *and* 1908.

Year.	Quantity.	Value.
	Tons.	£
1880	12,219	10,998
1881	11,163	10,047
1882	8803	7923
1883	8872	7985
1884	7194	6475
1885	6654	5989
1886	10,391	9352
1887	27,633	24,870
1888	41,577	37,420
1889	36,700	33,030
1890	50,519	45,467
1891	43,256	38,930
1892	36,008	32,407
1893	34,693	27,754
1894	30,499	24,399
1895	32,698	26,159
1896	41,904	33,523
1897	42,196	33,757
1898	47,678	38,256
1899	42,609	38,349
1900	50,633	44,227
1901	45,138	38,451
1902	48,863½	41,533
1903	49,069	41,709
1904	61,109	51,942
1905	51,993	44,194
1906	52,895¼	44,962
1907	58,891	50,057
1908	61,067¾	51,907
	1,053,226	902,072

No. 3.

RETURN showing the Quantity and Value of Tin exported from Tasmania during the Years 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, *and* 1904, *compiled from Customs Returns only, and Tin Ore produced during the Years* 1905, 1906, 1907, *and* 1908.

Year.	Quantity.	Value.
	Tons.	£
1880	3954	341,736
1881	4124	375,775
1882	3670	361,046
1883	4122	376,446
1884	3707	301,423
1885	4242	357,587
1886	3776	363,364
1887	3607½	409,853
1888	3775¼	426,321
1889	3764	344,941
1890	3209¼	296,368
1891	3235	291,715
1892	3174	290,083
1893	3128½	260,219
1894	2934	198,298
1895	2726¾	167,461
1896	2700	159,036
1897	2423½	149,994
1898	1972	142,046
1899	2239¼	278,323
1900	2029	269,833
1901	1789½	212,542
1902	1958¼	237,828
1903	2376$\frac{3}{10}$	300,098
1904	2171½	255,228
1905*	3891½	362,670
1906*	4472¾	557,266
1907*	4342¾	501,681
1908*	4520$\frac{4}{5}$	421,580
	94,036$\frac{1}{5}$	9,010,761

* Tin Ore produced : Customs having ceased to issue Returns.

Diagram showing Total Quantity & Value of Tin exported from Tasmania during the years 1880-1904 and Tin ore produced during the years 1905 and 1908

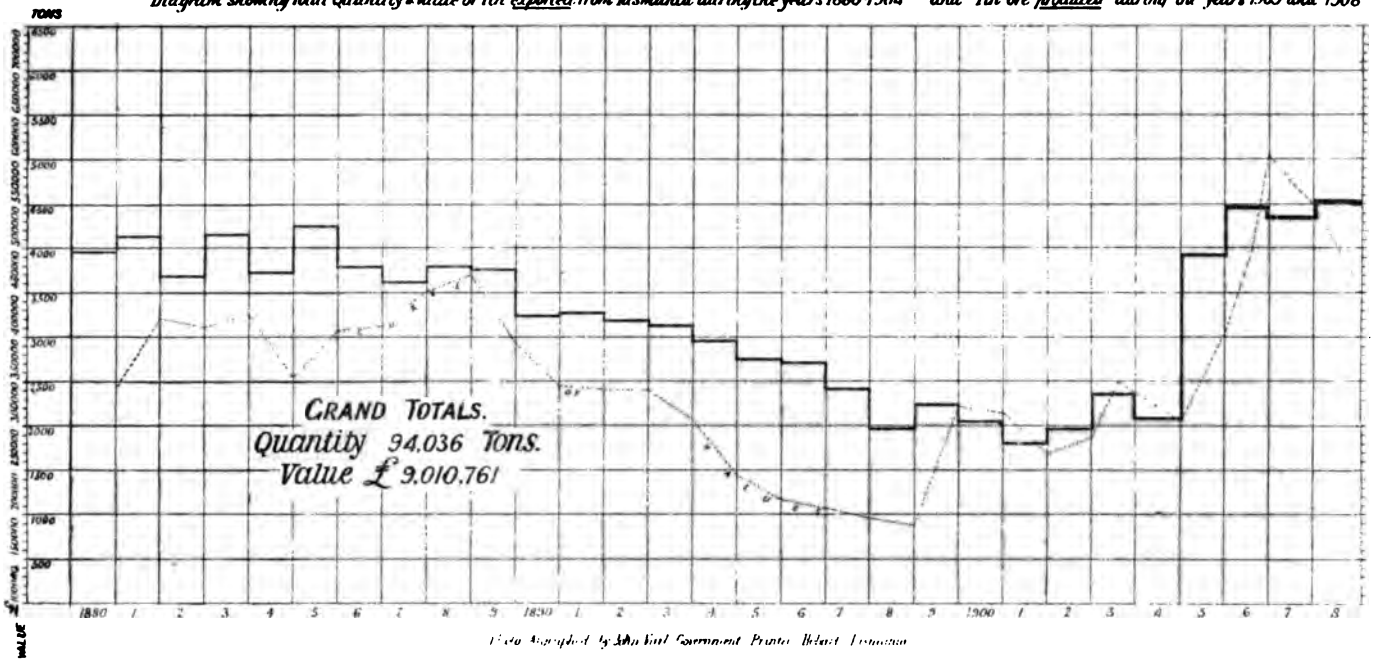


Photo Lithographed by John Vail Government Printer Hobart Tasmania

No. 4.

***RETURN** showing the Quantity and Value of Silver-Lead Ore produced during the Years* 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, *and* 1908.

Year.	Quantity.	Value.
	Tons.	£
1888	417	5838
1889	415	7044
1890	2053	26,487
1891	4810	52,284
1892	9326	45,502
1893	14,302	198,610
1894	21,064	293,043
1895	17,980	175,957
1896	21,167	229,660
1897	18,364	200,167
1898	15,320	188,892
1899	31,519½	250,331
1900	26,564	279,372
1901	28,774	207,228
1902	46,480	218,864
1903	42,422	192,492
1904	51,138	203,702
1905	75,270½	246,888
1906	87,117¾	462,443
1907	89,762½	572,560
1908	68,116$\frac{13}{20}$	322,007
	667,383$\frac{3}{20}$	4,379,371

No. 5.

RETURN showing the Quantity and Value of Blister Copper produced during the Years 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, *and* 1908.

Year.	Quantity.	Value.
	Tons.	£
1896	41½	1245
1897	4700	322,500
1898	4955½	400,668
1899	8598	735,305
1900	9449	907,288
1901	9981	879,625
1902	7745	*462,151
1903	6684	*478.023
1904	8371	*582.540
1905	8610	*704,287
1906	8708	*862,444
1907	8247	*832,691
1908	8833	*603,063
	94,923	7,771,890

* Value of Gold contained deducted.

No. 6.

RETURN showing Quantity and Value of Copper Matte exported during the Years 1902, 1903, 1904, 1905, 1906, 1907, *and* 1908.

Year.	Quantity.	Value.
	Tons.	£
1902	2500	50,112
1903	3727	83,624
1904	—	—
1905	—	—
1906	—	—
1907	—	—
1908	—	—
	6227	133,736

No. 7.

RETURN showing the Quantity and Value of Copper Ore produced during the Years 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, *and* 1908.

Year.	Quantity.	Value.
	Tons.	£
1896	34	1020
1897	75	2250
1898	394	8128
1899	1695	26,833
1900	4221½	63,589
1901	11,221	130,412
1902	5994	65,270
1903	102	790
1904	104	1640
1905	1150¾	52,939
1906	2234½	72,480
1907	788¼	36,975
1908	1185	6588
	29,199	468,914

No. 8.

RETURN showing the Quantity and Value of Iron Ore produced during the Years 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, *and* 1908.

Year.	Quantity.	Value.
	Tons.	£
1897	894	812
1898	1598	1598
1899	3577	3474
1900	5375	5995
1901	612	417
1902	2386	1075
1903	5980	2905
1904	6840	2975
1905	6300	2600
1906	2600	1100
1907	3000	1150
1908	3600	1600
	42,762	25,701

No. 9.

RETURN showing the Quantity and Value of Asbestos produced during the Years 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, *and* 1908.

Year.	Quantity.	Value.
	Tons.	£
1899	200	363
1900	128	113
1901	46½	45
1902	—	—
1903	—	—
1904	—	—
1905	—	—
1906	—	—
1907	—	—
1908	—	—
	374½	521

No. 10.

RETURN showing the Quantity and Value of Wolfram produced during the Years 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, *and* 1908.

Year.	Quantity.	Value.
	Tons.	£
1899	3½	99
1900	53¾	2058
1901	—	—
1902	—	—
1903	—	—
1904	15½	1147
1905	32½	2371
1906	19¾	1465
1907	40¾	4411
1908	4½	338
	170	11,889

No. 11.

***RETURN** showing the Quantity and Value of Bismuth produced during the Years* 1904, 1905, 1906, 1907, *and* 1908.

Year.	Quantity.	Value.
		£
1904	6 cwt.	15
1905	3½ tons	800
1906	6 cwt.	24
1907	3½ cwt.	27
1908	3¾ tons	462
	8 tons ½ cwt.	1328

No. 12.

***RETURN** showing the Quantity of Silver-Lead and Copper Ore smelted for period 25th June to 31st December,* 1896, *and 1st January,* 1897, *to 31st December,* 1908.

Year.	Ore Smelted.	Products.			Yield.			
		Silver-Lead Bull'n.	Blister Copper.	Matte.	Copper.	Silver.	Gold.	Lead.
	Tons.	Tons.	Tons.	Tons.	Tons.	Ozs.	Ozs.	Tons.
1896	26,028 1/10	—	—	2417 6/10	1235 1/10	75,951	4707	—
1897	90,773½	—	3476 1/2 0	257 16/10	3583 14/10	334,349	16,485	—
1898	170,933	—	4992	—	4783	606,123	24,418	—
1899	275,239	2295	8463	89 8/10	8362	1,089,657	27,615	—
1900	363,113	4817	9449	—	9341	1,215,036	26,255	—
1901	355,528	1839	9982	50	9880	800,317	21,717	—
1902	411,736	6825	7727	2882	8841	1,674,816	24,719	6654
1903	399,032	7560	6683	3413	8094	1,855,158	25,238	7529
1904	433,366	—	8371	—	8265	1,896,134	26,809	7754
1905	466,578	9422	8611	—	8596	2,075,431	26,469	9086
1906	479,775	9380	8708	—	8613	2,150,405	24,986	9300
1907	472,658	10,590	8248	—	8145	2,147,120	24,531	10,060
1908	440,145	7181	8834	—	8723	1,654,350	22,008	6850

No. 13.

RETURN showing the Average Number of Persons engaged in Mining during the Years 1880 *to* 1908 *inclusive.*

Year.	Number.	Year.	Number.
1880	1653	1895	4062
1881	3156	1896	4350
1882	4098	1897	4510
1883	3818	1898	6052
1884	2972	1899	6622
1885	2783	1900	7023
1886	2681	1901	6923
1887	3361	1902	5934
1888	2989	1903	6017
1889	3141	1904	6194
1890	2868	1905	6581
1891	3219	1906	7005
1892	3295	1907	7516
1893	3403	1908	6466
1894	3433		

No. 14.

RETURN showing the total Area of Land and Number of Sluiceheads of Water applied for during the Year ending 31*st December*, 1908.

Mineral.	No. of Applications.	No. of Sluiceheads.	Area.
			Acres.
Barium Sulphate	1	...	80
Coal	10	...	2200
Copper	79	...	3645
Galena	5	...	210
Gold	104	...	1374
Iron	2	...	15
Lead	1	...	40
Minerals	110	...	5037
Phosphate Rock	5	...	22
Silver	23	...	1854
Tin	181	...	3777
Wolfram	3	...	84
Machinery Sites	5	...	14
Dredging Claims	15	...	204
Water-rights and Easements	99	339	108
TOTAL	643	339	18,664

No. 15.

RETURN showing the total Number and Area of Leases issued during the Year ending 31st December, 1908.

Mineral.	Number.	Sluiceheads.	Area.
			Acres.
Antimony	3	...	240
Asbestos	1	...	10
Coal	6	...	852
Copper	43	...	2627
Gold	86	...	946
Iron	6	...	270
Minerals	122	...	6144
Manganese	1	...	63
Silver-Lead	30	...	2233
Shale	7	...	899
Tin	235	...	5759
Zinc-Lead	1	...	40
Machinery Sites	8	...	53
Mining Easements	30	...	105
Dredging Claims	22	...	255
Water-rights	138	489	50
	739	489	20,546

No. 16.

RETURN showing the Total Number of Leases in force on 31st December, 1908.

Mineral.	Number.	Sluiceheads.	Area.
			Acres.
Antimony	3	...	240
Asbestos	1	...	10
Bismuth	1	...	40
Coal	25	...	5623
Copper	44	...	2523
Gold	111	...	1344
Iron	15	...	758
Limestone	4	...	383
Lithographic Stone	1	...	97
Minerals	177	...	11,384
Marble	1	...	317
Manganese	1	...	63
Nickel	1	...	20
Phosphate of Lime	1	...	3
Precious Stones	1	...	80
Silver	124	...	7465
Slate	1	...	200
Shale	13	...	2125
Tin	894	...	21,099
Wolfram	5	...	374
Zinc-Lead	1	...	40
Machinery Sites	33	...	133
Mining Easements	88	...	453
Dredging Claims	64	...	916
Water Rights	511	2000	1003
	2121	2000	56,693

No. 17.

RETURN showing the Average Number of Miners employed during the Year ending 31st December, 1908.

	Europeans.	Chinese.
Northern and Southern Division	803	—
North-Eastern Division	700	62
Eastern Division	550	33
North-Western Division	517	...
Western Division	3801	...
	6371	95

NO. 16.

RETURN showing the Number and Area of Leases held under "The Mining Act," in force on 30th June in Years 1901 to 1903 inclusive, and on 31st December, 1903, 1904, 1905, 1906, 1907, and 1908.

Nature of Lease.	In force on 30th June, 1901.		In force on 30th June, 1902.		In force on 30th June, 1903.		In force on 31st December, 1903.		In force on 31st December, 1904.		In force on 31st December, 1905.		In force on 31st December, 1906.		In force on 31st Dec., 1907.		In force on 31st Dec., 1908.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.
		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.		Acres.
For Minerals, Silver, Tin, &c.	1388	60,865	1063	45,399	950	40,068	826	33,325	868	33,824	944	34,325	1307	43,036	1844	65,047	1269	44,099
For Coal, Slate, Shale, &c.	55	7566	52	7819	66	10,767	54	9119	47	7546	45	7185	35	6025	45	7962	45	8745
For Gold	566	6091	425	4166	310	3117	243	2505	222	2268	195	2087	167	1836	222	2671	111	1344
Dredging Claims	—	—	—	—	—	—	15	124	29	469	51	1196	91	2027	79	1494	64	916
Mining Easements	—	—	—	—	—	—	34	225	39	234	45	282	47	298	75	436	88	453
Machinery Sites	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	33	133
Water-rights Mineral and Gold	267	1318 sluice-heads	300	1691 sluice-heads	299	1514 sluice-heads	281	1460 sluice-heads	346	1495 sluice-heads	251	1477 sluice-heads	391	1606 sluice-heads	490	1978 sluice-heads	511	1003 & 2000 sluice-heads

No. 19.

RETURN showing the Amounts paid in Dividends by Mining Companies during the Year ending 31st December, 1908.

Mines.	Dividends.
	£ s. d.
Copper	210,000 0 0
Gold	...
Tin	126,298 0 0
Silver	11,462 0 0
Coal	906 0 0
TOTAL	£348,666 0 0

No. 20.

RETURN showing the total Amount of Rents, Fees, &c., received by the Mines Department during the Year ending 31st December, 1908.

Head of Revenue.	Amount.
	£ s. d.
Rent of Auriferous and Mineral Land	18,937 19 0
Fees, ditto ditto	1373 4 0
Survey Fees	2454 7 11
TOTAL	£22,765 10 11

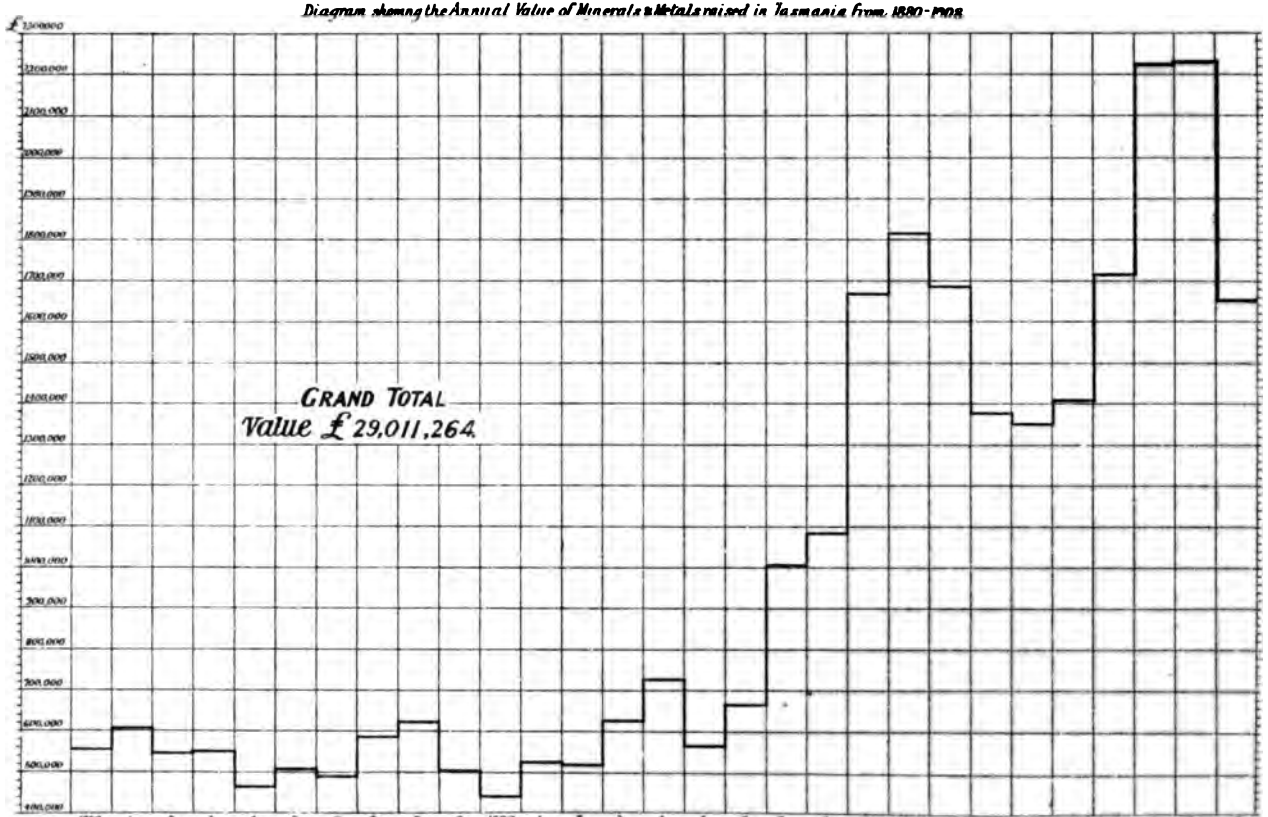
No. 21.

RETURN showing the Mining Companies registered during the Year ending 31st December, 1908.

Number of Companies.	Capital.
11	£106,850

In addition to the above, 14 Agents for Foreign Companies and 5 Syndicates, under 60 Vict. No. 51, were registered.

Diagram showing the Annual Value of Minerals & Metals raised in Tasmania from 1880-1908



No. 22.

RETURN showing Quantity and Value of Minerals and Metals raised in Tasmania from 1880 *to* 1908 *inclusive.*

Mineral or Metal.	Quantity.	Value.
		£
Gold	1,587,761 ozs.	6,273,153
Silver-lead ore	667,383 tons	4,379,371
Blister Copper	94,923 ,,	7,771,830
Copper Matte	6227 ,,	133,736
Copper and Copper Ore	29,199 ,,	468,914
Tin	94,036 ,,	9,010,761
Iron Ore	42,762 ,,	25,701
Coal	1,053,218 ,,	902,072
Wolfram	170 ,,	11,889
Bismuth	8 ,,	1328
Asbestos	374½ ,,	521
Unenumerated prior to 1894	...	31,988
Total	...	£29,011,264

No. 23.

COMPARATIVE Statement of Revenue from Mines, being Rents, Fees, &c. (exclusive of Survey Fees), paid to the Treasury for the Years ending 30th June, from 1880 to 1903, and for Six months ending 31st December, 1903, and for the Years ending 31st December, 1904, 1905, 1906, 1907, and 1908.

Year.	Amount.			Year.	Amount.		
	£	s.	d.		£	s.	d.
1880	8944	5	11	1895	15,323	1	9
1881	20,936	5	5	1896	20,901	13	2
1882	23,077	1	9	1897	25,631	0	3
1883	15,439	14	5	1898	33,661	13	9
1884	6981	11	10	1899	24,696	10	5
1885	11,070	5	7	1900	28,380	11	10
1886	12,523	10	4	1901	21,569	5	2
1887	14,611	11	5	1902	19,471	0	1
1888	23,502	8	4	1903	17,776	14	3
1889	17,254	9	0	1903, 1 July to 31 Dec.	14,758	17	1
1890	26,955	4	9	1904, Jan. to Dec.	16,631	8	2
1891	37,829	16	5	1905	20,208	17	0
1892	17,568	18	4	1906	24,136	12	5
1893	16,971	9	2	1907	24,794	7	7
1894	16,732	7	7	1908	20,311	3	0

The above Statement does not include Stamp Duties upon Transfer of Leases and Registration of Companies, nor the Tax payable upon Dividends, from which sources large sums are derived.

REPORT OF THE MOUNT CAMERON WATER-RACE BOARD FOR THE YEAR ENDING 31ST DECEMBER, 1908.

8th April, 1909.

SIR,

We have the honour to submit the report of the Board for the year ending 31st December, 1908.

Repairs.—That part of No. 13 flume, between the spot where Cascade Creek is picked up and the outlet of No. 1 syphon, a distance of about 6 chains, was overhauled and put into as good order as was possible under existing conditions. The best of the planks from the remainder of No. 13, which was replaced by a race cut into the solid, were used for this purpose; but the whole flume was in such bad condition as to render any lasting repairs out of the question. The Cascade Creek is one of the best summer supplies on the race, and it is advisable, when funds will permit, to extend the race which has recently been cut right up to the creek. The intake works and about 24 feet of the flume were wrecked by the heavy flood in February, 1907; this has been made good.

Alterations.—No. 13 flume, from the outlet of No. 1 syphon downwards has been replaced by a race cut into the solid. This was an expensive work, owing to the steep cross-section of the country, the number of large floating boulders, solid rock, and the proximity of the old flume. The new race is very solid and satisfactory, and disposes of trouble at that place for all time. It was necessary, if reasonably possible, to keep the water going during the cutting of the race, and great care had to be exercised to prevent damage to the flume from shots and spoil from the cutting. A part of the flume did collapse during the progress of the work, but fortunately the engineer was able to turn the water into the new race without much delay. He had started operations from the lower end to provide for such an emergency, as far as possible.

Renewals.

No. 4 Syphon.—This work, commenced the previous year, was completed in June last. The pipes are 30 inches in diameter, made of mildsteel plates 5 feet wide and ¼ inch in thickness, single riveted, and coated with a mixture of asphaltum and coal tar. The column is 3129 feet in length, fitted with 13 3-inch ball air-valves and two scour-valves. The joints are a combination of slip and flange, the general design being that four pipes are slipped together, the two end pipes having flanges on the outer ends. Two such sections are bolted together, and then a single pipe flanged at both ends, and carrying an air or scour valve, is bolted on. The course is straight; greatest depth below race-bottom at intake about 66 feet; fall between intake and outlet, 7.5 feet; pressure and discharge boxes are made of wood. The column

is laid on a different site from that previously proposed, giving a better pressure, and allowing the length to be shortened by about 540 feet, and the diameter by 3 inches; logs about 1 foot in diameter and 5 feet long are used as sleepers. About 10 chains of race was necessary to connect the new and old work at the intake end, and 5 chains at the outlet end. The new syphon was designed to take water from No. 1 dam, as well as from the main race. A low-level race had been cut from the dam and led into old No. 4 syphon at a level about 10 feet below the intake. The water is conveyed from the main race by means of an iron flume about 30 feet long, with a fall of about 6 feet, and then drops into a chamber in the new work on the same level as the race from the dam. The sides and bottom of the chamber are lined with logs about 1 foot thick.

No. 5 Syphon.—This was commenced during the year under review, and is nearing completion. The pipes are to be made similarly to those for No. 4, but will be 27 inches in diameter. The length of the column will be 4131 feet; difference of level between pressure and discharge-boxes, 15.5 feet: and the greatest depth below race-bottom at intake end, 82 feet. The column will be laid and fitted with valves similar to No. 4. A different course has again been selected, giving a straight run, sounder ground, and better facilities for junctioning with the race at either end, with an increase of only a few feet in the length of the column. About 4 chains of race had to be cut at the intake, and 1 chain at the outlet end.

Other Syphon Pipes.—Syphon pipes Nos. 1, 2, and 3.—These pipes are 30 inches in diameter, and were laid down at the same time as Nos. 4 and 5. Up to the present time, however, they have not given much trouble, but are now showing signs of corrosion, and a few bands have been put on where bursts have occurred.

No. 6 Syphon.—This pipe is 2508 feet in length and 36 inches in diameter. Frequent bursts have occurred during the year, and 56 bands have had to be put on to repair the damage. It is only reasonable to expect that as time goes on more frequent breaks will occur, but with constant care and attention we hope to be able to keep it in repair for a couple of years.

Flumings.—Out of 23 wooden flumings, 12 have been replaced by earth and rock cuttings and embankments, and made permanent, leaving 11 still to be done, as already informed in previous reports. These flumings are in a very bad condition, and must be cut out or replaced by earth and rock cuttings as soon as possible. It was hoped that the revenue derived from the sale of water during the year would have been sufficient to provide for the expense, but unfortunately our hopes were not realised owing to the very dry winter and to the collapse of No. 5 syphon, there not being sufficient water to meet the requirements of customers.

Maintenance and Management.—The Board has been as economical as possible during the year, and has been able to reduce the expenditure by £341 16s. 9d., as compared with the previous year. The services of one of the channel-keepers

were dispensed with, the work being undertaken by the manager, thus saving an expenditure of £120 16s.

The revenue amounted to £649 6s. 7d., being a decrease of £307 6s. 2d., as compared with the previous year.

Statistics for the year are as follows :—

Average per week of claims supplied, 12.
Greatest number supplied in any one week, 16.
Total number of heads supplied :—

Under fixed or cash scale	42½
Under royalty or credit scale	1973
Total	2015½

Tin ore raised for the year :—Royalty scale, 28 tons 12 cwt. 1 qr. 17 lbs.; Fixed scale, 16 tons 8 cwt. Total, 45 tons 1 qr. 17 lbs.

Average number of men employed per week, 23.

Total receipts for the year :—Water sold, fixed scale, £47 10s. 3d.; water sold, royalty scale, £589 4s. 10d.: other receipts, £12 11s. 6d. Total, £649 6s. 7d.

Expenditure.—Cost of maintenance and management :—

	£ s. d.	£ s. d.
Salary and wages	483 4 0	
Repairs to syphon pipes	42 14 9	
Repairs to flumings	3 8 0	
Travelling expenses	8 19 10	
Stores and tools	3 3 5	
Stationery and printing	1 13 1	
Insurance	3 6 0	
		546 9 1
No. 13 flume, repairs and deviation	...	304 7 4
No. 4 syphon (6 Edw. VII. No. 23)	...	2873 2 6
No. 5 syphon (7 Edw. VII. No. 31)	...	560 12 5
Completion of overflow channel at intake	...	15 13 4
		£4300 4 8

Moiety of rents of mineral land served by the race paid to Public Debts Sinking Fund for the year ending 30th June, 1908, £32 7s. 6d.

W. H. WALLACE, Chairman.
W. H. TWELVETREES,
EDWARD L. HALL,
JOHN SIMPSON,
SAMUEL HAWKES,
} Members of the Board.

The Hon. the Minister for Mines.

MINE MANAGERS' EXAMINATION.

March 24th, 1908.

Subject—Mining.

1. A mine has been opened up to a depth of 150 feet, and there is a daily flow of 30,000 gallons of water, of which ¼ is making in the sump. What size of pump would you put in to allow opening up to a depth of 500 feet? What size of shaft would you require? Show by sketches how you would place the pitwork in the shaft. Assume various conditions.
2. Describe in detail the method you would adopt for signalling in a shaft at present 500 feet deep, and which, in addition to an output of 100 tons a day, has to be sunk 100 feet a year in wet ground.
3. A lode, dip about 60 degrees, varies in width from 3 to 6 feet, and is payable throughout. Describe how you would stope it out, and at what vertical distances apart you would place your levels—
   (1) With good standing walls;
   (2) With bad standing walls.
4. Describe the safety appliances you consider necessary in connection with winding from mines, and how you would test winding-ropes and connect them to winding-engine and cage.
5. A drive on a lode is timbered with 12-inch timber; a stope is being brought up below it. How would you pick up the level—
   (1) In good ground;
   (2) In heavy ground.

   Give sketches.
6. Describe the various machines and appliances used in connection with the ventilation of deep mines, and methods of distributing fresh air to the various working faces.
7. Describe the different methods of driving in running ground.
8. Describe, with sketches, a rock-drill.
9. Describe the ordinary explosives used in mining, and for what special purposes would you use each, and what precautions would you take in using them.
10. What would you consider the most economical method of removing 1,000,000 cubic yards of overburden 100 feet deep, consisting of partly decomposed basalt containing boulders up to a ton weight? Describe the methods and the plant you would use.
11. Describe the methods and appliances used in a hydraulic-sluicing machine.
12. You are required to work a deep alluvial gold lead with much water in it. Describe, with sketches, how you would set about it.

SUBJECT—ORE-DRESSING AND SAMPLING.

1. Describe a canvas table. What are its advantages and disadvantages?
2. Compare a jaw-breaker with a gyratory-breaker. Which would you prefer, and why?
3. Describe a system of sampling from the faces of a quartz mine to the tail-race, to obtain the value of the ore in the mine, to test the different appliances in the battery, and to test the saving of the battery as a whole.
4. Describe the appliances you would use in a concentrating plant to treat 20 tons of silver-lead ore per 8 hours when the ore is in coarse and fine particles through the gangue.
5. How would you sample a shipment of 20 tons of black tin?
6. Describe in detail a machine for treating coarse sand containing 5 per cent. of—
   (1) Iron pyrites;
   (2) Galena;
   (3) Cassiterite;
   and state what percentage of the contents you would expect to save in each case, and what weight of concentrates you would obtain from 100 tons treated.

SUBJECT.—SURFACE WORK.

1. Give sketch design of a trestle bridge 30 feet high for a train of mine trucks.
2. Give sketch plan of an ore-bin to hold 100 tons of quartz.
3. Give sketches showing pit-head gear for a self-dumping skip in a vertical shaft.
4. In designing a water-pipe for a power scheme, do you consider it wise to have large pipes at the top of the column and smaller ones at the bottom?
   Give your reasons in the following cases:—
   (*a*) A column everywhere under a low head;
   (*b*) A, say 30″ column, for first 200 feet under 60-feet head, and for last 1000 feet under head rapidly increasing to 600 feet.
5. How would you make comparisons between the motive-powers for machinery of a large mine in a locality where fuel is fairly cheap and inexhaustible, and water-power may be obtained at considerable initial cost?
6. Two steel plates, each $\frac{3}{4}$-inch thick, are lap-jointed and riveted together by two rows of $\frac{3}{4}$-inch steel rivets, the pitch being 3 inches, and the rows $1\frac{3}{4}$ inch apart. What is the least percentage of strength of the joint?
7. If a water-pipe be made with joints as in the previous question, and is 36 inches internal diameter, what head of water would it safely carry?
8. Neglecting friction and the weight of the lever and valve, what proportions must exist between the different parts of a safety-valve of the lever and ball type in order that the addition of each pound weight on the end of the lever just balances an increase of one pound pressure in the boiler?
9. What would be the indicated horse-power of a single-cylinder high-pressure steam-engine having a cylinder

20 inches in diameter by 36 inches stroke: revolutions, 60 per minute; average pressure throughout the stroke, 30 lb. per square inch? What brake horse-power would you expect from the above engine?

10. The lower end of a water-pipe 600 yards long from a reservoir is under a head of 115 feet. For the first, or upper, 400 yards this pipe has an internal diameter of 6 inches; at the lower end of the pipe a jet 1¼ inch in diameter discharges 227 gallons per minute. What is the smallest diameter of the lower 200 yards of the pipe?

SUBJECTS.—ARITHMETIC, MENSURATION, AND MINING ACCOUNTS.

1. Find the value of

$$\frac{(3\frac{1}{2} - 2\frac{1}{2}) \div \frac{1}{2} \text{ of } \frac{1}{2}}{2\frac{2}{3} \div (\frac{1}{4} + \frac{1}{4})}$$

and express the result as a decimal.

2. Two cog-wheels work together, one having 360 teeth and the other 100. If the first revolves 20 times in one minute, how many times will the second revolve in an hour? And if the latter turns a drum whose circumference is 5 feet, how many miles of thread will it wind upon the drum in a working-day of 11 hours?
3. Find the number of tons of firewood contained in a stack of the following dimensions:—Bottom length, 90 feet 6 inches; top length, 45 feet 9 inches; height, 10 feet; in 5-feet lengths; reckoning 50 cubic feet per ton.
4. Find the dividend on £6894 13s. 4d., at 1s. 3d. in the £
5. Four men dig a trench in 15½ days, working 10 hours per day each. Supposing them to have worked 8 hours a day, how many days would they have occupied?
6. Describe the books and form of accounts which you consider desirable for controlling the receipts and distribution of stores.
7. Name, describe, and give illustrations of the accounts and statistical returns which a mining manager might be expected to send in monthly to the head office.

SUBJECT—MINING GEOLOGY.

1. Explain briefly the various theories which claim to account for the filling of metalliferous veins.
2. Define the terms—

   Zone of Oxidation;
   Vadose Circulation;
   Barysphere.

   Give the chief ores of silver, lead, copper, and zinc existing at depth and those usually met with near the surface, accounting for the presence of the latter.
3. Describe briefly the development of methods for the recovery of faulted veins, and illustrate present-day methods by an example.
4. Give any examples of secondary enrichment you know of, with your explanation of the occurrences.
5. Give any examples you can of the effect of wall-rock on the metallic contents of lodes.

6. What do you understand by the terms slickensides and flucan, and what class of vein do they usually indicate? Give examples; *or* give examples of banded structure with your explanation of its formation.
7. Describe any system of deep leads with which you are acquainted, and discuss the probable source of metallic contents as a guide to exploitation.

SUBJECT—MINING SURVEYING.

1. Describe the usual methods of ascertaining horizontal distances in surveying.
2. Give field notes of the survey of a mine with a main shaft and two levels, as required annually by the Mines Department.
3. In selecting a theodolite, what would be the principal points of construction to which you would pay attention, and how would you test them?
4. Describe carefully the adjustment of the transit theodolite.
5. Describe the level, and the precautions you would take in using it to ensure accurate work.
6. A winze is sunk on a vein of varying underlie. Describe your method of survey, and give field notes.
7. The tangents of a 10-chain curve include an angle of 120°. Shew how to set the curve out by offsets and deflection angles, giving the necessary calculations.
8. In a certain traverse, it is impossible to measure the lengths of two sides not contiguous, but their bearings and lengths of other sides and bearings are obtained. Shew how you would obtain by latitude and departure the length of the sides and area of figure.
9. Describe any method of ascertaining the True Meridian.

SUBJECT—MINING LAW.

All questions are required to be answered.

1. How would you neutralise the fumes arising from an explosion of nitro-glycerine which cannot be effectively disposed by ventilation?
2. How should cages be covered for protection to persons ascending or descending shaft?
3. At what angle should ladders be placed in a shaft for the convenience of miners? What space should be allowed between the rungs of such ladders; and what space must be allowed between the rungs and the wall?
4. What is the limited length of rope or chain ladders which may be used in a shaft during sinking operations?
5. In raising or lowering men, what is the limited rate of speed at which a cage or bucket is allowed to travel?
6. What provision is required to be made in a mine which is liable to an inundation or burst of water?

The following Lists of Certificates granted since the inception of the Board of Examiners for Mining Managers' Certificates are published in accordance with a resolution passed at the Interstate Conference of Boards of Examiners held in Melbourne in March, 1906 :—

SERVICE Certificates of Competency granted by the Board of Examiners.

No. of Certificate.	Name.	Date of Certificate.
1. 92	Davies, Joseph	28 Sep. 1892
2. 92	Buffon, Geo. Donald	28 Sep. 1892
3. 92	Sinclair, George Peace	28 Sep. 1892
4. 92	Heighway, John Felton	28 Sep. 1892
5. 92	Irvine, Peter	28 Sep. 1892
6. 93	Daniel, John	29 Mar. 1893
7. 93	Marshall, John Henry	29 Mar. 1893
8. 93	Aaron, Gabriel	29 Mar. 1893
9. 93	Webb, George	29 Mar. 1893
10. 94	Payne, John Greaves	3 Apr. 1894
11. 94	Wesley, William Henry	3 Apr. 1894
12. 94	Andrews, Thomas	3 Apr. 1894
13. 95	Richards, Moses John	17 Apr. 1895
14. 95	Richards, Stephen Eddy	5 Nov. 1896
15. 98	Stubs, Joseph Thomas	20 Jan. 1898
16. 98	McCrackan, John	20 Jan. 1898
17. 98	Heery, Luke	5 Mar. 1898
18. 98	Curtain, Cornelius Henry	13 Apr. 1898
19. 98	Clerk, Frederick Malcolm	14 Apr. 1898
20. 99	Craze, John	25 Jan. 1899
21. 99	Tilley, George Reynolds	17 Apr. 1899
22. 99	Hooper, Thomas Martin	17 Apr. 1899
23. 99	Vincent, Thomas	17 Apr. 1899
24. 1900	Brown, William	9 Jan. 1900
25. 1900	Rosewarne, David Davey	4 Oct. 1900
26. 1901	Buddon, William	1 Mar. 1901
27. 1901	Yeates, Alexander	29 Apr. 1901
28. 1902	Ireland, Mark	22 Apr. 1902
29. 1902	Woolcock, John	23 Sep. 1902
30. 1903	Powell, Robert William	5 May, 1903
31. 1904	Muir, John James	27 July, 1904
32. 1904	Moyle, John	5 Dec 1904
33. 1904	Ridley, John	12 Dec. 1904
34. 1906	Brough, Daniel	23 Apr. 1906
35. 1906	Berrill, Samuel	23 Apr. 1906
36. 1906	Barker, George	24 July, 1906
37. 1907	Wisch, John G. A.	6 Nov. 1907

COLLIERY Certificates of Competency granted by Board of Examiners.

No. of Certificate.	Name.	Date of Certificate.	Class of Certificate.
1. 92	Brain, Austin Lionel Bennet	28 Sep. 1902	First class
2. 1907	Wallace, Archibald Campbell	23 Apr. 1907	Second class
3. 1907	Williams, Thomas James	8 May,1907	First class

CERTIFICATES of Competency granted by the Board of Examiners.

No. of Certificate.	Name.	Date of Certificate.	Class of Certificate.
1. 92	Dunstan, Alfred John	28 Sep. 1892	First class
2. 92	Ekborg, Benjamin Pherson	28 Sep. 1892	Second class
3. 92	Hill, Charles	28 Sep. 1892	Second class
4. 92	Booth, John Robert	28 Sep. 1892	Second class
5. 92	Stapleton, Michael	28 Sep. 1892	Second class
6. 92	Lewis, Philip	28 Sep. 1892	Second class
7. 92	Hanlon, Christopher	28 Sep. 1892	Second class
8. 92	Williams, Luke	28 Sep. 1892	Second class
9. 92	Macandrew, Harold	28 Sep. 1892	First class
10. 92	Harris, William	28 Sep. 1892	First class
11. 93	Stapleton, Michael	29 Mar. 1893	First class
12. 93	Hanlon, Christopher	29 Mar. 1893	First class
13. 93	Potter, Joseph Matthew	29 Mar. 1893	First class
14. 93	Hilder, Alfred	29 Mar. 1893	Second class
15. 93	Matthews, Peter	29 Mar. 1893	Second class
16. 93	Richards, Stephen	6 Sep. 1893	First class
17. 94	Brain, Austin Lionel Bennet	3 Apr. 1894	First class
18. 94	Thorpe, Walter	3 Apr. 1894	Second class
19 95	Williams, Luke	17 Apr. 1895	First class
20. 96	Levings, Joseph Henry	6 May,1896	First class
21. 99	Goodall, Thomas Charles	14 Apr. 1899	Second class
22. 1900	Schloesser, Robert	19 May,1900	First class
23. 1900	Nicholls, Charles Berresford	19 May,1900	First class
24. 1900	Sale, William Robert	19 May,1900	Second class
25. 1900	Williams, Richard	19 May,1900	Second class
26 1900	McPeake, John	1 Aug. 1900	First class
27. 1901	Sawyer, Basil	20 Feb. 1901	First class
28. 1902	Provis, John	22 Apr. 1902	First class

CERTIFICATES of Competency—continued.

No. of Certificate.	Name.	Date of Certificate.	Class of Certificate.
29. 1902	Bird, Robert Chisholm	22 Apr. 1902	Second class
30. 1902	Briggs, William Albert John	22 Apr. 1902	Second class
31. 1902	Bartlett, William Henry	22 Apr. 1902	Second class
32. 1902	Phœnix, William	22 Apr. 1902	Second class
33. 1902	Wright, Herbert E.	22 Apr. 1902	Second class
34. 1902	Craze, John	30 Apr. 1902	Second class
35. 1903	Waller, Richard Fitzarthur	5 May,1903	First class
36. 1903	Brickhill, Hector Gordon	5 May,1903	First class
37. 1903	Barker, Reginald Fredk.	5 May,1903	First class
38. 1903	Vincent, Thomas Henry	5 May,1903	First class
39. 1903	Crittendon, James Henry	5 May,1903	First class
40. 1903	Weston, Eustace Moriarty	12 Aug. 1903	First class
41. 1903	Clark, Lindesay Colin	31 Aug. 1903	First class
42. 1904	Martin, Edward Patrick	17 Feb. 1904	First class
43. 1904	Herman, Hyman	29 Apr. 1904	First class
44. 1904	Murray, Russell Mervyn	29 Apr. 1904	First class
45. 1904	More, George Allan	14 Oct. 1904	First class
46. 1905	Beamish, William Abraham	3 Jan. 1905	First class
47. 1905	Andrews. Thomas J.	1 May,1905	Second class
48. 1905	Hitchcock, William E.	1 May,1905	First class
49. 1905	Smith, George Oliver	18 July,1905	First class
50. 1906	Rockett, Hildreth Peyton	23 Apr. 1906	Second class
51. 1906	Hales, Richard Chilman	23 Apr. 1906	Second class
52. 1906	Debenham Arthur John	28 June,1906	First class
53. 1906	Coote, Charles Edward	18 Oct. 1906	First class
54. 1907	Marks, Oscar Sidney	8 Mar. 1907	First class
55. 1907	Phelan, Bernard Fredk.	23 Apr. 1907	Second class
56. 1907	Moline, Arthur Howard Pritchard	23 Apr. 1907	First class
57. 1907	Macartney, Ross Kenneth	23 Apr. 1907	First class
58. 1907	Williams, Thomas James	8 May,1907	First class
59. 1908	Hooke, Arthur Warner	18 Mar. 1908	First class
60. 1908	Adams, Oliver Linley	25 Apr. 1908	First class
61. 1908	Seal, Leonard Presley	19 Nov. 1908	First class

GEOLOGICAL SURVEY OF TASMANIA.

REPORT OF THE GOVERNMENT GEOLOGIST.

Geological Survey Office,
Launceston, 1st June, 1909.

SIR,

I HAVE the honour to present my report for the year ending 31st December, 1908.

During the year I have made the following examinations :—

1. The Country in the Vicinity of the Great Western Railway-line.
2. The Goldfields of Lisle and Cradle Creek.
3. The Gunn's Plains and Alma Mineral Districts, North-West Coast.

The report on Gunn's Plains was not finished at the end of the year.

Mr. L. K. Ward, B.E., Assistant Government Geologist, has been engaged on the following work during the year :—

1. Preparation of Bulletin No. 3 on the Mt. Farrell Mining Field.
2. Exploration of the Route of the Great Western Railway Survey.
3. Geological Survey of the Tinfield of North Dundas.

The preparation of the North Dundas Bulletin was in progress at the end of the year. Mr. Ward's annual report is attached hereto.

Western Exploration.

For the first three months of the year, the services of Mr. Ward and myself were utilised by the Lands Department, under an Exploration Act passed by Parliament in 1907, for or towards effecting the following purposes, viz. :—

1. Exploring the country lying within 20 miles or thereabouts north and south of the route surveyed for the Great Western Railway.
2. Constructing tracks and means of crossing rivers to enable prospectors to reach any apparently mineral-bearing places which may be discovered or are already known.
3. Obtaining a report upon—
   (*a*) The agricultural land;
   (*b*) The timber;
   (*c*) The minerals;
   (*d*) The scenery and probable tourist resorts in the region to be explored.

The geological survey was charged with the duty of exploration and reporting upon the geological and scenic features of the country explored. The reports were furnished to the Surveyor-General, and published in the report of the Department of Lands and Surveys for 1907-8, with accompanying topographical and geological maps.

My exploring party traversed the country from Tyenna as far north as the Gell River, and west to the Prince of Wales Range.

Mr. L. K. Ward took a party from Gormanston to the King William Range. I started from Hobart on the 24th January, and returned on the 2nd April; Mr. Ward left Launceston on the 18th February, and returned on the 9th of April.

Our reports deal in detail with the geology and physiography of the country traversed, and it would be out of place to reproduce them here; but it is perhaps advisable to refer to the results, and repeat some of the published observations, in view of the circumstance that the publications of the Mines Department circulate principally among those interested in mineral exploration.

Although the examination of this *terra incognita* did not result in any important discoveries of mineral, the journeys may be said to have been useful in more than one respect. They served to dispel the vague, nebulous ideas which have so long floated in the minds of many respecting the mineral wealth of this unknown tract of country. Sound and definite information has now been gained, dissipating the haze which engendered false hopes, and might even injuriously affect public policy itself. It is now known that though sporadic and limited occurrences of ore may be met with, the geology of the area is such as to forbid the hope that any part of it will ever yield a first-class mining field. However unpleasant this conclusion may be, it was worth while going to the trouble and expense of the examination necessary to arrive at it. It is better to know the worst than to dream dreams. Another and important direction in which the exploration has certainly given results of value, is the opportunity which it has afforded geologists of becoming acquainted with geological features, which are proving of the utmost use in correlating and interpreting strata in the mining fields of the north and west. A basis has been in this way secured for conclusions hitherto only drawn tentatively in more than one mining district. Journeys of this kind are a necessity for compiling our long-proposed geological sketch-map of the island, and connecting stratigraphically widely separated mineral fields. In still another respect the exploration has been of use, namely, in placing us in a position to produce a geological section of nearly the entire width of the island. To complete the traverse the line requires to be continued down the Gordon from the Serpentine River and to Point Hibbs on the West Coast; and further north, from the Frenchman's Cap to Mt. Darwin and Macquarie Harbour. The latter traverse would enter the known mineral belt at the Darwin Range.

I am of opinion that this kind of traverse should, in future, form a permanent feature of the work of the Geological Survey. The best time for undertaking them is in the summer, when the weather is favourable for exploration in the highlands. I strongly advise that they be incorporated as an integral part of the functions with which the survey is charged. They will result in placing our knowledge of the structure of mining fields on a broad and sound basis, and are in essential harmony with the basic principle which underlies all geodetic

survey work, namely, to proceed from the whole to the part; not from the part to the whole. To confine operations to separated mining fields and to neglect the structure of the intervening country, is to reverse this important rule, and cloud our knowledge of the mining areas themselves with partial, empirical interpretations.

The methods here insisted upon are in unison with those officially adopted by the United States Geological Survey, an organisation which stands in the first rank as regards broad and enlightened practice. It may be permitted in this connection to quote a few pregnant sentences from the instructions which it places in the hands of its officers :—

"In field study of economic mineral deposits, the geologist should bear in mind that his results, to have their greatest value, must be based on a thorough knowledge of the geologic relations of the deposits. If he does not obtain this knowledge, his work will be a more or less complete failure, no matter how many facts he may ascertain regarding the deposits themselves. If time for the study of a deposit is limited, a considerable share should be devoted to the general geology of the district in which it occurs—to its geologic and physiographic history—although these matters may to the superficial observer appear to have little, if any, bearing on the subject under investigation."

Such exploratory traverse work might also be made of service to the cause of education by attaching to the party as cadet or assistant a university science student, who would be glad to join in the work, gaining experience for himself, and contributing to the final report in the form of maps or observations.

As an example of a traverse of this sort, I might instance one across the country between the Forth and Mt. Farrell. This would embrace an area, the geological structure of which is but little known. It would assist in the geologic interpretation of the country lying further north. It would pass across mineral-bearing strata, and it would connect the mining fields of Farrell and Middlesex. The impending investigation of the Mt. Balfour ore-deposits will also be incomplete without an examination of the hinterland to the immediate east of the mining field proper. It has been necessary to make these comments, because individuals have represented to me how improper it is that geological journeys should be taken into areas where mineral occurrences are not likely to be of importance. This objection is based principally on imperfect acquaintance with the principles of our investigations. Slight, and perhaps unusual, indications in any given district often assist greatly in interpreting normal deposits elsewhere; and observations of the outcrops and boundaries of geologic systems, wherever they may be found, are of guiding value in estimating the economic importance of the strata met with in the mining fields. Unless a fund of reliable data has been collected, from which conclusions can be drawn, the mere inspection of mine workings yields minimum results.

The exploration journey this year showed that below the Permo-Carboniferous mudstones and mudstone conglomerates which flank the Tyenna and Russell's Falls River valley lies

the Ordovician limestone, which has survived as far east as the Junee River. Exposures of this limestone were seen on the Humboldt Divide, in the Florentine Valley, and in the valley of Rasselas. Further west it was noticed in the valley of the Denison River. Approaching the summit of the above divide, it attains an elevation of 2000 feet above sea-level. In the valley of the Florentine its exposures are 1400 feet above sea-level; and in the valley of Rasselas, between 1500 and 1600 feet. As it is also met with in the Franklin River valley and along the Lower Gordon, extending also to near Point Hibbs, on the West Coast, it was evidently at one time continuous over the greater part of the area now occupied by the island. Limestone, apparently belonging to the same formation, occurs in the south, at the New River; and in the north, on the Sophia River, Blythe River, Leven River, at Gunn's Plains, Mole Creek, Chudleigh, Railton, Winkleigh, and Beaconsfield. The fossil contents—Actinoceras, the coral Tetradium (Dana), Raphistoma, Orthis lenticularis (?)—have caused these strata to be referred to the Ordovician; and in Tasmania they are considered to be at the base of that system.

At Railton, in the north of the island, the limestone rests unconformably upon Cambrian sandstone, containing the characteristic Upper Cambrian trilobite, Dikelocephalus; and on the Humboldt Divide and on the flank of Tim Shea (Mt. Stephens) yellow sandstones with the same fossil form apparently underlie the same calcareous strata. Near the Humboldt Mine, at the foot of the Needles, cherty and chocolate-coloured silicified slate of presumably Cambrian age can be seen to pass below Tim Shea and the overlying limestone, heading in a north-west direction for the Florentine Valley.

In the valley of Rasselas the limestone which forms its floor is underlaid by the pebbly sandstone quartzite and conglomerate beds which rise into the Thumbs, Mt. Wright, and the Denison Range, and which are interpreted as being of Cambrian age. The Gordon River crosses bars of this limestone, which here strikes N. 25° W., and dips north-east at an angle of about 70°. The strike of the underlying conglomerate series to the west is similar, and the dip is in the same direction; but the angle of the latter is only 50 degrees. To the same system belongs the limestone which at Beaconsfield overlies the sandstone and conglomerate beds traversed by gold quartz reefs in the Tasmania and other mines.

The limestone at the Upper Blythe River also reposes on the conglomerates and slate series which enclose the well-known copper and iron-ore deposits. The Gunn's Plains limestone, too, rests on the cupriferous breccia and slate series of the Dial Range. Its relations, therefore, seem to be fairly constant everywhere, making allowance for lithological differences in the conglomerates; and it consequently becomes highly important to fix its position in the geological record with certainty. The exploration journey has been of value in this respect, and in throwing light on the one hand on the relations between the Cambrian and the Ordovician, and on the other between the Cambrian and the Algonkian.

What is probably the Lower Cambrian is represented by the sandstone and conglomerate beds of which the Denison Range

is composed, beautifully exposed, and forming an easily recognisable belt between the Ordovician of the valley of Rasselas on the east, and the Pre-Cambrian schist region on the west.

As a result of these journeys, precise observations of the boundaries of a large part of the schist region have been made for the first time in the history of Tasmanian geology, and the true nature and age of the schists themselves ascertained.

Once the Denison Range was crossed, successive chains of the quartzite and sericitic schists continued with a dreary monotony as far west as the expedition penetrated, and it appears that they extend still further west to the coast itself, interrupted on the meridian of Pillinger and Darwin by the schistose rocks of Lyell, which are a younger series, and have an entirely different origin.

As regards the mineral resources of the country traversed, it is perhaps not safe to suggest the absence of mineral from parts of the country not absolutely on the route which was followed. Ore-deposits may possibly be discovered at isolated spots, provided that igneous rocks favourable to the deposition of ore are found to exist in the vicinity. I have been informed that serpentine occurs on the Boyes River, on the west fall of the Denison Range. Possibly some mineral veins may be found in that neighbourhood. Some gold-bearing schist was found at the Gell River by Mr. J. L. A. Moore, and a little work might very well be done at this spot with a view of ascertaining—firstly, whether the schist there is solid and undisturbed; and secondly, whether any formation can be found or signs of lode-action traced. The minute particles and streaks of gold observed were in the substance of samples of ordinary sericitic quartzite schist, such as forms miles of mountain ranges to the west.

Apart from the above, only unimportant occurrences of pyrites were met with in the schist area. The conclusion was irresistible that, failing the discovery of favourable igneous rock, the hope of any important mining field springing up on the line of route taken by the expedition is extremely slender. Moreover, the regularity of the contours of the mountain crests, and other surface outlines, indicated no change in the geology of the country further west and south within a considerable distance of the route. In the absence of the acid eruptions of the West Coast Range, or of such rocks as the great granite masses of Heemskirk, and the Meredith Range and other similar foci of ore-concentration, a sanguine forecast for this great schist area is not justifiable. The scattered occurrences of alluvial gold which have been reported from time to time from the Gordon, Franklin, and Jane rivers, while denoting that a little deposition has taken place, are not sufficient to shake the main conclusions arrived at. Once, however, the Lyell-Darwin meridian is reached, conditions are entirely changed, and a true mineral belt is entered. A good deal of limonite, or bog iron ore, was seen in the Florentine Valley, and these occurrences appear to have been trenched and otherwise prospected, in the hope that they would prove to be outcrops of mineral lodes. It is, however, for the most part an impure yellow hydrated oxide of iron,

mixed with ferruginous clay, and a wash of quartz and quartzite stones, without indications of any lode mineral.

At the eastern base of the Needles, however, the Cambrian slates and quartzites are traversed by copper and lead-bearing lodes. A copper-ore outcrop was discovered in 1891, and at different times some work has been done in connection with this lode. Three openings have been made on it at intervals over a vertical distance of about 150 feet. In the open cross-cut at the outcrop, the lode is 4 feet wide, and consists of a gangue of quartz., barites, and calcite enclosing narrow veins of copper pyrites, accompanied by a little galena and zinc blende. About 60 feet below this, a drive has been commenced on the lode, which is 9 to 10 inches wide, in a gangue of quartz and carbonate of iron, with spurs of quartz projecting into the country from an irregular ill-defined hanging-wall. At the entrance, a spur of quartzose veinstone appears to have yielded most of the copper ore which was obtained.

About 100 feet below this is the adit-level, which has been driven along a well-defined foot-wall. In the face, the lode is 2½ to 3 feet wide, consisting of barren quartz and spathic bands 6 to 9 inches in width, separated by lode slate. A cross course traverses the drive a few feet from the end, following the strike of the country strata N. 70° W. The country-rock is indurated chocolate-coloured slate and quartzite, dipping north-easterly, and evidently its prolongation westerly passes below Tim Shea and the Humboldt Divide. It must be referred to the Cambrian. A gossan outcrop was discovered by Mr. Clark north and east of the copper lode, and parallel with it. A shaft has been sunk on this, and a few trenches cut, without disclosing anything beyond the iron oxide. Southwards, and also parallel with the principal lode, a galena-copper lode has been found and trenched. The gossan outcrop above mentioned has shed boulders of limonite over the hillside, and it is almost certainly the upper part of a lode.

Whether these lodes are dominantly copper or galena lodes cannot be stated until more work is done on them. A wide gossan band occurs on the track between the mine and Tyenna, but no work has been done on it. This belt was the only zone in which I met with decided indications of ore-deposits, and there would seem to be some possibilities in it. A system of beds traversed by defined lodes carrying appreciable quantities of copper, &c., cannot well be passed over by the prospector. The country at the base of the Needles and Tim Shea is covered with timber, and the track to the mine from Tyenna is badly overgrown. Having in view the fact that undoubted ore occurrences exist, it is highly desirable that this track be kept open.

These journeys may prove of use to prospectors by indicating to them the routes which will best give access to the mountainous wilderness which they wish to explore, and by giving them some reliable notion of what they may expect to meet with. Tracks leading into the heart of the country have been staked out, and can be easily followed. It is scarcely necessary, and perhaps not possible, to keep all the tracks open. They have mostly been of an exploratory nature, made with a view of ascertaining whether the country would

warrant much expenditure on them. When it has been decided which routes will be the main lines of communication, those selected will have to be kept clear and open, and food depôts established at suitable central spots. The provision difficulty is the principal bar to the prospector. He cannot carry on his back all the requisite food; and, unless he can replenish his stock somewhere near his field of operation, he is not in a position to make any serious attempt to enter and tarry in the great desolate land.

It will be noticed that the exploration journeys, and the preparation of reports thereon, occupied the greater part of the first half of the year, reducing the time available for current examinations of mining districts. Under the circumstances, this was unavoidable.

Visit to Zeehan.—In my last, I accompanied you in a journey to Zeehan, which you made in response to a telegram of urgency received from that town asking for immediate remedial measures to cope with the situation created by the temporary suspension of the smelting works there.

The result of the journey was embodied in a joint report. Ministers had already decided in principle on the question of granting an advance to the smelters. When this was given effect to the critical situation was dissipated; however, information was gained on the spot which may be useful in the future.

Lisle and Cradle Creek Goldfields.—In July and September I examined this district, famous for having been the most important alluvial field ever worked in Tasmania. At one time it had a population of 2500. The Bessell Bros. discovered it in December, 1878, and there was an immediate rush of miners to it, and a consequent enormous output of alluvial gold. This feverish activity lasted for three or four years, and then the number of workers gradually decreased, until to-day, there are not more than a couple of dozen. The total yield of the field to date, according to the most trustworthy accounts, approximates to a quarter of a million ounces; and this has been won from a fraction of a valley floor not more than a mile and a half square. The bed of the main creek and rich terraces of detritus on the eastern side of the valley have produced the bulk of the gold. A portion has also been won from creeks and terraces on the opposite side. As might be expected, the workings in the main creek have been the largest producers. The terraces, though they were exceedingly rich in places, have not yielded anything like the same amount, and the best gold in them was obtained from the few feet of clayey wash lying on the bottom, though it was present also in the upper part of the terrace, consisting of angular and sub-angular hill drift. The floor of the valley is granite, always soft granite in the workings, of the Golconda and Camden Plains type. This rock extends up the slopes of the surrounding hills for a height of 400 or 500 feet, and then junctions with slate and sandstone. The invasion of these sedimentary rocks by the granite has silicified them, and given birth to abundant secondary mica and incipient audalusite. The actual contact is concealed below a heavy overburden of clay and detritus, greatly impeding prospecting operations. Although

these sedimentary strata are traversed by some veins of quartz, from some of which perhaps gold is not entirely absent, specimens of gold-bearing quartz are practically absent from the alluvial workings. These would undoubtedly have been abundant if the gold won had been derived from ordinary quartz reefs. The inference, accordingly, appears to be a legitimate one—that the metal has come from soft seams of mica or kaolin in the granite, or from either soft formations or impregnations at or near the granite contact. It will not be easy to prospect these owing to the overburden, which uniformly hides the contact line and covers the hill sides, and, when found, the distribution of gold in them may turn out to be irregular. Nevertheless, the probability is that in places they will be found rich enough to work. Where so much gold has been shed in such a limited area, it does seem likely that large quantities of it have been left *in situ*. Two miles north-west of Lisle are the Cradle Creek and Tobacco Creek sections, on the latter of which gold was discovered 18 months before the discoveries at Lisle. The two creeks have returned about 2000 ounces of gold. Three or four years after work was started at the Lisle diggings a rush took place to these creeks, but the reefs or veins which shed the gold were not found. The natural features of the country indicate clearly that the gold which has been obtained from the two creeks was derived from quartz reefs or veins in the hill which separates them. The Ordovician country south of Lisle consists of ancient sandstone and slate strata, which are traversed here and there by dykes of hornblendic granite, usually in an advanced stage of decomposition. These have probably some connection with the granite of Lisle to the north, and of Diddleum and Camden Plains to the south.

North-West Coast Mining Fields.—In October and November, I examined the mineral districts of Gunn's Plains and Alma, and at the same time visited some mineral occurrences at Stowport.

Some work has been carried on at Gunn's Plains, on Copper Creek (charted as Walloa Creek). An upper adit has intersected a copper ore lode 5 feet wide, with a siliceous brecciated slate gangue, bearing south-east. In a lower adit, what appears to be the same lode has been intersected, carrying a sprinkling of copper and iron pyrites in a calcite and slate matrix. Nothing has been done beyond cutting the lode at these points and trenching at surface, so that it remains now to prove the value of the lode by driving on its course and opening it up. A few other mineral indications exist in the district, but none of such definite character as the Copper Creek lodes. Most informative knowledge was gained on this journey of the geology of the country in which these ores occur. The Dial Range series of tuffs, breccias, and conglomerates have been recognised as occupying a well understood position in the geological record. The knowledge of their possibilities as foci of ore-distribution may be expected to contribute to important economic results in the exploration of other areas of similar structure.

Some of the peculiar breccias of the Dial have been recognised this year by the Assistant Geologist in the Dundas field, and as the porphyroids prevalent in the former district are

known to occur at Bell Mount, it is probable that they continue also to the Black Bluff and Stormount areas, and will be found there, too, to be associated with minerals worth looking for. It is the same geological complex which encloses the lodes of the copper ore mine at Alma, between the Forth and Wilmot Rivers. Exploratory work has lately been done there by the Alma Prospecting Syndicate, in the shape of sinking on a gossan outcrop, and driving to intersect its downward extension. A little surface-cutting has been carried out on an outcrop of barytes on this property.

A visit to Stowport, fortified by the observations made at the Dial and Alma, disclosed that, though the igneous breccias are absent there, the slate, conglomerate, and quartzite strata comprising the country near the Blythe River belong to the same geological system. At Stowport, however, they appear to be within the range of influence of the granite invasion, as the ordinary Devonian granite is exposed on their southern limit. The precise limits of the respective influences of the porphyroids and granite need further study before the genesis of many of our ore-deposits can be properly understood. It seems a pity that exploration work has been suspended at the Rutherford mine before it was really completed. All through these coastal shows the same unfinished state of things prevails. Prospecting or development work has not been pushed to a definite conclusion, and consequently it cannot be said whether the coast is likely or not to embrace mining districts of value. All that can be stated for the present is that there is a field for prospecting work, and that the indications encourage perseverance. The geological examination leads one to recognise a wide area in which the conditions for ore-deposition appear to have existed.

Oil Shales.—In pursuance of your instructions, I prepared, in December, an account of the oil shales occurring in Tasmania for the Commonwealth Statistician. This report embraced information respecting the Tasmanite shale of the Mersey district, the kerosene shale or cannel coal of Preolenna, and the cannel or pelionite of Barn Bluff. A copy is appended hereto.

Geology of Tasmania.—In accord with the practice which has been adopted of furnishing the Commonwealth Statistician with a succinct account of the geology of the island, brought up to date, at the end of each year, I compiled a revised sketch of the outlines of our geology, as far as has been worked out to the end of December. The enlarged area taken in by our recent exploration journeys and other field work has added to our knowledge, and in some points necessitated revision of some hitherto accepted parts of the stratigraphical record. As fresh knowledge is gained with successive years, such adjustments must be expected from time to time.

Office.

The correspondence this year embraced 2326 letters, reports, &c., in and out. The office library has been added to by bulletins, reports, and other publications received from the geological surveys and mines departments of other countries, and our reports have been duly transmitted to them in

exchange. Acknowledgment, with thanks, is tendered to the proprietors of the following papers:—"Daily Telegraph," "Daily Post," "Launceston Examiner," "Zeehan and Dundas Herald," "Australian Mining Standard," "Queensland Mining Journal," "New Zealand Mines Record," "New York Engineering and Mining Journal," "Mining Journal," (London), "Australian Mining and Engineering Review." The collection of ores prepared for Dr. E. Weinschenk, University of Munich, was completed and despatched. Special thanks are due to the Mount Lyell Mining and Railway Company the Mt. Bischoff Tin Mining Company, the Magnet Silver Mining Company, and the Anchor Mines, Limited, for their assistance in making this collection as representative as possible.

Every opportunity is taken in the field to gather material for such collections; but the demands are increasing, and it is becoming increasingly difficult to satisfy them, for many of the localities are visited but seldom. Care is being taken to restrict these donations to public institutions, or authors, who will make a *bonâ fide* use of the material.

Mr. F. S. Grove was, to the end of the year, still occupied with renewals to the Mt. Cameron Water-race. From the beginning of April, Mr. W. D. Reid acted as clerk and draftsman to my entire satisfaction.

The question of office-accommodation is still pressing, and can apparently only be disposed of by hastening the erection of the new technical school building, when the school staff and students will vacate their present quarters in the Public Buildings, and enable at least two additional rooms to be occupied by the Geological Survey. One room is required for the Assistant Government Geologist and for the drafting in connection with his maps, and a workroom for depositing and testing ores and rocks. These rooms can be secured in the building quite adjacent to the present offices. It is hoped that this will become practicable without any great further postponement.

With our newly organised system, an increasing attention is being devoted to surveying and mapping, and this inevitably renders increased drafting assistance necessary. With a single draftsman it seems impossible to keep up with current work or to undertake the preparation of such further maps as the mining community and the public generally are entitled to expect. We have in view special maps, which it is intended to issue as soon as drafting facilities exist, such as maps showing the distribution of ores in the island, maps illustrating the distribution of igneous rocks, &c.; and there is the further important work of issuing a new map of the geology of Tasmania. This latter can only be thought of when we are able to keep a draftsman at work on an office chart, transferring the field results as they come in.

As large areas are continually coming under observation, with the result that the mapping becomes a very important part of our system of work, additional assistance in this respect appears to be imperative if any reasonable standard of efficiency is to be maintained. The further accommodation mentioned above in this report will, in any case, become more urgent than ever.

Geological Survey Collections.

The minerals, ores, and rocks collected from time to time in the field have of necessity accumulated to an extent which prevents their storage in the office, and most of them have had to be put away in boxes and bags in the Government Store, where they are difficult of access, and altogether hidden away from the public.

An opportunity now presents itself for their conservation and display in the Victoria Museum, Launceston, which has recently been enlarged (with Parliamentary funds) for the addition of a mineral gallery, which it is intended to arrange so as to represent the mineral resources of the State. The survey collections could undoubtedly be housed there, and be displayed with advantage to the State. The transfer would relieve the office from overcrowding with specimens, and would also turn to real use the collection at present lying idle in the store. It would also place representative ores and products in a position where they could always be seen by the public, and easily referred to by the Department.

The want of ability to refer quickly to any of the specimens stored is an inconvenience which is at present seriously felt by the geologists. I venture to suggest that, under proper conditions, the arrangement here proposed would prove of benefit to the public, the State generally, and the Department in particular. It would be necessary to devote a little time to the arrangement of collections, but perhaps not more time than is lost at present when reference is required to specimens which are packed up.

Analytical Work.

The absence of facilities for this continues to be felt, and I am afraid that the drawback will persist until definite arrangements are made with the Government Analyst. There is no difficulty in having our mine samples assayed, and I am not alluding to this branch of the work. I refer rather to systematic quantitative analyses of our minerals and rocks, such as are undertaken by Government laboratories elsewhere. Our weakness in this particular respect is unsatisfactory.

Conclusion.

Reviewing the work for the past year, the progress made in the examination of the structure and resources of large areas of the island has been considerable, and the additions made to our knowledge of the economic value of certain districts must inevitably prove of use and benefit to the State.

In the coming year the districts of Mt. Balfour, Mt. Claude and King Island will be the subjects of much-needed investigation.

I have, &c.,

W. H. TWELVETREES, Government Geologist.

W. H. WALLACE, Esq., Secretary for Mines, Hobart.

REPORT OF THE ASSISTANT GOVERNMENT GEOLOGIST.

Launceston, 1st June, 1909.

SIR,

I HAVE the honour to present the following report on the work upon which I have been engaged during the year ending 31st December, 1908 :—

From 1st January until 18th February I was engaged upon the preparation of the bulletin dealing with the Mt. Farrell mining field. This has since been published as Bulletin No. 3 of the new series of publications of the geological survey.

At the conclusion of the work connected with the preparation of this bulletin, I proceeded to the West Coast in connection with the geological exploration of the route of the proposed Great Western Railway. That portion of the route which lies between Gormanston and the King William Range was examined by me during the period between 18th February and 9th April.

The preparation of my report, and the execution of the plans in connection with this work, occupied my time until 22nd June. The report and maps have been published in the report of the Department of Lands and Surveys for 1907-8.

On 22nd June, in accordance with instructions, I proceeded to North Dundas to undertake the geological survey of that tinfield. The field work in connection with this survey occupied the period from 22nd June to 14th October, and from that date I have been in Launceston engaged upon the preparation of the plans and geological report.

A summary of the principal results of my observations during the year is here appended.

Exploration of the Route of the Great Western Railway.

The rapid traverse of a considerable area to the east of Gormanston has enabled me to place upon record many of the salient geological features of this area. In some cases the stratigraphical relationships between some of the strata met with could not, in the time at my disposal, be determined; but, at least, the boundaries of these strata were ascertained and their lithological characters examined.

Special attention was paid to the economical aspects of the area as regards possible mineral contents, and a part of the time of the expedition was taken up with the systematic prospecting of the area. When regarded from this point of view, the country between Gormanston and the King William Range is certainly disappointing, for our prospecting operations met with negative results in all cases. This is the more remarkable on account of the immediate proximity of the well-marked zone of mineralization which follows a meridional course along the West Coast Range. Yet there was discovered no eastward extension of this metalliferous belt.

The principal ore-bodies of the Mt. Lyell district are located on the line of junction between the Mt. Lyell schists and the West Coast Range conglomerate.

The Mt. Lyell schists constitute the foliated mantle of a persistent belt of porphyritic igneous rocks which are known to traverse the western portion of the island from the north coast at Penguin to Birch's Inlet on Macquarie Harbour, and probably still further to the southward. I have described in detail a portion of this igneous belt in my report on the Mt. Farrell mining field.

The West Coast Range conglomerate forms the bulk of the capping of the several mountains which have been grouped together under the name of the West Coast Range. The formation is essentially a quartzose one; the component pebbles consisting of several varieties of quartz, quartzite, and quartzite-schist. Some further mention of this conglomerate is made below.

The relation of the conglomerates to the igneous schists has not yet been determined, and the question of this relationship is one of great importance. The view has been expressed that the siliceous sediments have been deposited upon the schists, but the recent work of the geological survey, in correlating the strata in various parts of Tasmania, shows that the view hitherto held is at least open to question.

The ore-bodies of Mt. Lyell are situated on, or in the immediate vicinity of, the contact, between these two formations. The reason is not that the metallic ores have been derived from either formation, but because the fissures (now filled with ore) have, in a manner the cause of which is thus far undetermined, followed very closely the line of junction of the two formations.

Detailed investigation of this region is necessary before any sound and scientific deductions can be made, which might lead to a confident statement regarding the possible extension of the ore-bodies beyond the limits thus far empirically delineated.

It may, however, be here stated that there appear to be no reasons, based on geological observations, why, under favourable conditions, ore-bodies should not be found within the boundaries of the conglomerate, which has hitherto been regarded by prospectors as quite unfavourable.

On passing eastwards, the geology is found to change abruptly at the King River. The sudden change from the rugged peaks and ridges of the West Coast Range conglomerates to the broad plains of the King River valley, worn down in dark slate, is striking. There seems to be some probability of the existence of a great fault-plane coinciding with the eastern border of the West Coast Range.

The relationship of the slate to the siliceous conglomerate was not determined. To the eastward of this belt of slate lies a narrow strip of river-borne alluvial, in which boulders of diabase are prominent. Beyond this alluvial deposit there is a marked difference between the country lying to the north and that that to the south of the Nelson River. On the low hills to the northward, the country consists of sandstones and shales of Silurian age. These cannot, from their observed dip, be conformable with the slates of the King River valley. Moreover, from the absence of all signs of crushing in the members of this formation, the period of sedimentation which

is here represented followed after that of the crushing of the slate.

South of the Nelson River the Raglan Range rises abruptly and towers above the low hills of sandstone mentioned above. It is composed of rocks which, while showing variations in composition and structure from point to point, must yet be considered to constitute a geological unit. These rocks are, in the majority of cases, schistose; but some varieties have only a slaty cleavage, and others, again, are massive. In composition they are not complex, consisting, as they do, mainly of quartz and sericitic mica in varying proportions.

The quartzites are often remarkably free from all other ingredients than silica, and form dense non-schistose masses.

Closely allied to these massive white quartzites are the quartzite schists, in which a slaty cleavage or actual foliation is shown. These are due to the development of extremely tenuous films of sericite, which in some varieties are hardly visible. With the increase of the sericitic ingredient, these quartzites pass over into mica schists, which are distinctly foliated.

The age of these rocks could not be ascertained from the evidence obtainable in this area alone. The quartzitic and micaceous schists form the floor upon which the subsequent slates and Silurian sandstones have been deposited. These schists are covered by the Silurian sandstone as far to the eastward as the Collingwood River. Beyond this point they are exposed for miles north and south of the Linda track, and continue to the eastward as far as Mt. Arrowsmith, which forms the western escarpment of the central plateau.

No other rock-type is represented by any considerable outcrop throughout all this area. Some few intrusions of igneous material were detected, but these were of very small extent. Their presence is, however, significant.

Near the junction of the Collingwood and Cardigan rivers there were discovered some short lenticular veins of coarse pegmatite. These are only visible on the banks of the Collingwood River, but their presence is highly suggestive. The pegmatite seems to have undoubtedly been derived from a granitic magma, no other representation of which has thus far been found in this neighbourhood. Granite is known to outcrop at Granite Tor to the north, and at Cox's Bight to the south of this locality, and in both places it is stanniferous. It may be, therefore, that there is an axis of intrusion extending in the direction of these known outcrops, and that the pegmatite in the Collingwood River valley lies on that axis. And in confirmation of the supposition that a granitic mass is not far below, mention should be made of the fact that the mica schist in this place carries a number of small and irregularly formed veinlets of, either quartz alone, or quartz and tourmaline. The prospecting of this area gave only negative results. The other rocks to which an igneous origin is attached, and which penetrate the mica schists, are a few dykes of a garnetiferous zoisite-amphibolite. These rocks resemble closely those of Hamilton-on-Forth, and may be on an axis of intrusion which antedates that of the granite by several geological periods; for the zoisitic amphibolite is markedly schistose, and its schistosity appears to have been

superinduced contemporaneously with that of the mica schists alongside. The quartzitic schist of Mt. Arrowsmith is succeeded on the eastern slope of the mount by a softer mica schist. Upon this softer schist, to the north of the Linda track, there lies a small hill of reddish quartzite, which is identical in lithological characters with the quartzite, interlaminated with the West Coast Range conglomerate; and also with the quartzites which are associated with the Cambrian conglomerate of the Denison Range. All of these similar outcrops are, in my opinion, separated portions of one and the same formation. Hence the information gathered by Mr. Twelvetrees regarding the age of the formation (the evidence of the succession at the Denison Range) has proved of inestimable value in assigning an age to these rocks.

To the eastwards of the quartzite, the lower-level country consists of the typical Upper Mesozoic diabase This diabase also caps the tops of the neighbouring mountains (Mt. Gell, Mt. Rufus, the Loddon Range, and King William Range). However, the two outcrops of diabase are not continuous on the surface between the King William Plains and the capping of the range; for, on ascending the mountain, a considerable thickness of Permo-Carboniferous sandstone was found lying about horizontally on the flanks of the mountain. The diabase seems, therefore, to form two sills, of which the upper one has a much greater westerly extension than the lower one. I was unable to effect a junction with Mr. Twelvetrees in the time at my disposal, and a small strip of country remains unexplored between the furthest points reached by us during the work of exploration.

The Geological Survey of the Tinfield of North Dundas.

The tinfield of North Dundas is situated between the Ring River and the Argent River, and therefore occupies a position intermediate between Zeehan, Rosebery, and Dundas. The nearest mining fields therefore are areas in which ores of silver and lead predominate. Yet there are exhibited signs of a genetic relationship between the tin ores of North Dundas and the ore-deposits of the nighbouring mining fields. These relationships will be fully discussed in the report now being prepared. With the nearest occurrences of tin, viz., at Zeehan, Heemskirk, Stanley River, and Granite Tor, the genetic relationship is still more fully expressed by the geological features of the North Dundas field. The geology of the area is fairly simple.

The oldest rocks on the field are the Dundas slates, to which, on recent evidence, a Cambro-Ordovician age has been assigned. These are intersected by, and interlaminated with, rocks of igneous origin. The interlaminated rocks are consolidated tuffs, similar to those observed by me at Mt. Farrell, and to those recently collected by Mr. Twelvetrees in the gorge of the Leven River, and on the coast at Penguin. They belong to the effusive phases of the eruption of quartz-porphyries and felspar-porphyries to which I have referred above in dealing with the origin of the Mt. Lyell schists. Some intrusive masses belonging to this period of igneous invasion were found at North Dundas, but they are of small extent, and unimportant. The second period of igneous invasion was that of

Devonian age, when there were introduced a complex series of basic rocks—gabbros, norites, pyroxenites, and peridotites. With these basic rocks are associated later dykes of quartz-porphyry in the central portion of the field. The relation between the acid and basic rocks is identical with that observed in other parts of Tasmania, viz., at Trial Harbour, and at Anderson's Creek, near Beaconsfield. It seems probable that in all these localities the juxtaposition of the acidic and basic groups is caused by the operation of some regular process or processes. There are several pieces of evidence which form a strong argument in favour of the view that the process known as magmatic differentiation has been the cause of the constantly recurring association of acidic with basic types. This argument will be presented in some detail in the forthcoming report.

At a still later period the field was again invaded by igneous material, of which the only remaining trace is a long dyke of diabase. The only other formations represented in the field are unconsolidated river deposits. One of these makes the wide plain of erosion of the older Pieman River, through which the present river has deeply corroded its way. The genesis of the ore-deposits of the field dates from the Devonian igneous intrusion. With the progress of solidification, the magma became increasingly more acidic in composition, until a quartz-tourmaline rock, sometimes carrying tin ore, was evolved. Between this differentiation product and a typical vein-stuff containing the same mineral, no line can be drawn. Besides these tin-bearing rocks having an obvious connection with the igneous reservoir, there are the stanniferous lodes which have been deposited in pre-existing fissures from solution. The most common vein-type in this field is a pyritic one which at first sight does not resemble a typical tin ore. The principal metallic ingredient of the unoxidised ore is pyrrhotite, and, in smaller proportions, there occur pyrite, arsenopyrite, chalcopyrite, and a little galena and zinc blende. The most plentiful gangue mineral is quartz, and a little dolomite usually accompanies it. Besides these, fluorite, tourmaline, chlorite, and epidote are present. Still more remarkable is the structure of these pyritic-cassiterite lodes, for the ore seldom occurs as the filling of a simple fissure. The surface features appear to include the presence of more complex lode-systems, which show a great variety of form. The essential component parts of these systems are a series of vertical or steeply inclined ore-bodies, filling fractures which cut across the slate, and a number of more nearly horizontal ore-bodies which conform with the bedding-planes of the slate. The approximately vertical lodes may be termed "feeders," and those more nearly horizontal may be termed "floors." These complex lode-systems owe their structure to the character of the forces which caused the fracturing of the crust, and to the readiness with which the slate cleaves in the direction of the bedding-planes. There are two such lode-systems on the field, and these both have a general strike in a north-west-south-easterly direction.

The pyritic-cassiterite ore in these lodes has been largely altered by the progress of weathering, and two very distinct varieties of oxidised ore have resulted. On the one hand, the

"floors," where they closely conform to the present surface of the ground, have been partly oxidised. The surface portions of the ore-body have been almost totally deprived of the metallic minerals other than cassiterite. There has, in these cases, been no gossan formed, and the reason is that the organic acids resulting from the vegetation immediately above the ore have rendered soluble the iron compounds.

Almost the whole of the recent output of the field has been maintained by the working of these oxidised floors. The more vertical components of the lode-systems, and those floors which dip into the hill slopes have, with the progress of weathering, given rise to gossans of normal appearance. In some places the gossan ore carries a high percentage of tin, but none has yet been crushed.

In the neighbourhood of Pine Hill the pyritic-cassiterite type gives place to the more normal quartz-tourmaline-cassiterite type.

Little work has thus far been done on these veins, which traverse both the slate and granite-porphyry. In the latter rock there is sometimes a complete network of veinlets, between which the porphyry has been considerably altered by the vein-forming solutions. A certain amount of cassiterite has thus been introduced into the wall-rock of the veins, and an attempt should be made to ascertain whether the proportion of tin ore is sufficiently high in some of these veins and zones of impregnation to render the working of them profitable.

Other minor occurrences of vein-matter will be duly described in the report, and their possibilities indicated.

The secondary ores on the tinfield are not of great consequence. Tin ore is very widely distributed in the alluvial deposit of the older Pieman River, but not in sufficient quantities to render this formation payable. Tin ore has recently been found in Dundas, and a beginning has been made to open up the deposits. A visit was paid to this locality, and a description will be given of the mode of occurrence of the tin ore there.

Practically no lode mining has been carried on up to the present time in this field. A few prospecting tunnels have been driven, and the work has been abandoned when pyritic ore was met with. The structure of the complex lode-systems has clearly not been understood.

The time has now come for the companies working on the detrital ore to start operations upon the unoxidised lode-matter. The detrital ore remaining on the surface, and the oxidised ore in the lodes, cannot last long, and until some systematic exploration of the lodes has been carried out no accurate idea can be formed of the future possibilities of the district. The Boulder Tin Mining Company has recently erected a small crushing plant and concentrating mill, and the Renison Bell Company is beginning to follow this example.

General Deductions drawn from the Observations made during during the past Year.

There are two main features of interest brought out by the work upon which I have been engaged during the past year, and both of them have an important economic significance.

The first of these is that connected with the correlation of the West Coast Range conglomerates and quartzites with the similar rocks of the Denison Range, and concerning which there is now definite evidence concerning age, which is held to be Cambrian. This is a matter of economic importance in that the great majority of the ore-deposits in Tasmania are genetically connected with the invasion of igneous material in Devonian time. It follows, then, that the Cambrian rocks may well serve as *loci* for ore-deposition, and should be prospected with care in the neighbourhood of the igneous intrusions.

The second important general deduction is that which concerns the essential unity of origin of the acidic and basic members of the igneous rocks, which attained their present position in Devonian time.

The occurrence of these rocks at North Dundas has been brought into correlation with other occurrences in Tasmania, and valuable inferences may be drawn. It will be pointed out in the forthcoming report on the North Dundas tinfield that the relation of the basic to the acidic rocks finds expression in the occurrence of a tin-bearing lode near the Dundas township, with no other adjacent igneous rocks than serpentine. Yet this seeming anomaly is satisfactorily explained by the known relationship between the serpentine and the granite.

This observed case of the association of tin ore with serpentine is closely allied to that of the limuritic vein-matter of the Colebrook Mine, with a similar rock; and both occurrences should be borne in mind in future prospecting.

The igneous complex of acidic and basic rocks referred to here is not separate and distinct from other occurrences in Tasmania. Precisely similar associations occur in several other places, and the general features of the North Dundas tinfield might profitably be kept in view by those who may be engaged upon the prospecting of geologically similar areas.

I have, &c.,

L. KEITH WARD, B.A., B.E.,
Assistant Government Geologist.

REPORT OF THE CHIEF INSPECTOR OF MINES.

Chief Inspector of Mines Office,
Launceston, 12th May, 1909.

SIR,

I HAVE the honour to present my report on the inspection of mines for the year ending 31st December, 1908. I append statistical tables and diagram showing the number and nature of accidents which have taken place in and about the mines and works in connection with mines during the year.

I also beg to attach the annual reports of the Inspectors of Mines, viz.:—Mr. M. J. Griffin, Inspector for the Northern and Southern, Eastern, and North-Eastern Divisions; Mr. Jas. Harrison, Inspector for the Western and North-Western Divisions; and Mr. C. H. Curtain, Inspector for the Lyell District.

The number of men engaged this year at the different mines and smelting works was 6464. The number of fatal accidents was 6; and of non-fatal serious injuries, 58. The death rate from accident was 0·928 per thousand, against 0·798 in 1907.

In the five fatal cases at Lyell, it is difficult to see that further or more effective protection could have been provided for the unfortunate victims. Two seem to have lost their balance, and fallen from the ore-bench at which they were working; one infringed the mine rules, and knocked the cage away prior to entering it, getting crushed by the moving cage in some unexplained way; the fourth lost his life from a fall of rock, which he appears to have known was unsound; and the fifth had his thigh broken by a slab of schist falling away from the side of a pass which he was timbering. He believed it to be safe, but a sudden bulge took place, and the slab fell. The sufferer became convalescent, but, after six weeks, suddenly died from a clot of blood in the lungs.

The sixth fatal accident was caused by a workman at the Tasmanian Smelters attempting to put a belt on without waiting for the machinery to slow down. It was the custom to await until the slowing down took place. The coroner's jury recommended the adoption of a more complete system of signalling, and that no belts should be replaced except when the engine is working at a minimum speed or is stationary; also, that such work should only be entrusted to an experienced person. The unfortunate youth was 17 years of age.

Health of Miners.—This continues to receive the inspectors' attention. Defective ventilation and insanitary conditions have to be closely watched and remedied. On the whole, the mines throughout the State are fairly ventilated, and sanitary conditions good.

Enquiry from the medical officers in various mining centres, as well as from Dr. Elkington, the Chief Health Officer, has shown that, so far, ankylostomiasis, or miner's worm disease, is happily unknown here. The latter informs me that he has made enquiries in the principal mining districts without eliciting anything which would lead him to suspect its existence. He also informs me that, in going through the statistics for a

number of years back, he found a case here and there reported as ankylostomiasis, but on enquiry these turned out to be due to other causes defectively described. Filth and moisture, combined with warm temperature, are the underground conditions in which the worm spreads and establishes this serious complaint. When the worm is thoroughly established in any mine in which it has found a home, it is rarely or never entirely eradicated. We have, however, an effectual preventive remedy in our hands, viz., insistence on strict attention to sanitary details underground, and to proper ventilation.

The lung disease, generally known as miner's phthisis, has occasionally been recorded by medical men; but how far it is prevalent and to what extent it was contracted in our mines are matters concerning which I have not been able to obtain definite information. It is stated that in the few cases which have been recorded the patients had worked previously in mines outside the State, or, if in the State, outside the district, and the origin of the complaint was consequently not under observation. Dr. Elkington states that, while there is undoubtedly some incidence in Tasmania, the disease is nothing like so prevalent as in some districts elsewhere in the Commonwealth. Until phthisis is proclaimed a notifiable infectious disease, it does not appear possible to obtain precise information of the occurrence of cases among the mining population. Men who are working rock-drills may be expected to be those who would show the most acute and unmistakable symptoms. The rock dust which they inhale is the primary and producing cause of the disease, and machine-drill men are undoubtedly more exposed to it than any other class of miners. Dry mines and dry holes are conditions favourable to the contraction of this distressing and disastrous complaint. Apart from the rules attached to "The Mining Act," the impulse of common humanity should inspire mine-owners to adopt every measure or appliance calculated to prevent the deadly inhalation of rock dust by those whom they employ underground. The inspectors have been enjoined to be especially on the alert in this matter. For the ordinary dust after firing, and in connection with work in dry stopes, much relief can always be given by adequate ventilation and avoiding the return of men until the dust caused by blasting has been dissipated.

The following is a list showing the number of persons killed and injured during the year 1908 under each branch of the mining industry:—

Gold mines	18
Silver-lead mines	16
Tin mines	8
Copper mines	22
Total	64

Legislation.—During the year an Act to amend "The Mining Act, 1905," was passed, in which several important changes were made.

New provisions for reporting accidents were introduced, and sections regulating mine labour on Sundays were embodied in the Act. Work, other than work of necessity or mercy, is pro-

hibited, and labour which may be considered as included in the latter category is set forth in full. Among the amended working rules is one relating to pent-houses in shafts. During shaft-sinking operations no work in any other place in the shaft, nor any hoisting to or from any other place in the shaft, is allowed, unless a pent-house is put in below these places, so as to protect men working in the bottom of the shaft. Adequate overhead protection, to the satisfaction of an inspector of mines, for men engaged in shaft-sinking, is always to be provided. Several other useful amendments of rules found to be necessary in practice were included in the Act. An Act to regulate the buying of gold was passed on the 14th December. The Act provides for licensing gold-buyers and gold-assayers, and prohibits the sale of gold, except by a bank, by any person who assays or smelts gold. Inspectors of mines are authorised to take proceedings against any licensee or other person for any contravention of the Act.

I have, &c.,

W. H. TWELVETREES,
Chief Inspector of Mines.

W. H. WALLACE, Esq., Secretary for Mines, Hobart.

COMPARATIVE Table of Statistics of Accidents in and about the Mines of Tasmania from 1st July, 1892, to 31st December, 1908.

Period.	Number of Miners employed.	Number of Accidents.	Number of Persons.		Total killed and injured.	Average per 1000 killed and injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
1 July, 1892, to 30 June, 1893	3295	28	4	25	29	8·8001	1·214	7·586
„ 1893 „ 1894	3403	25	7	20	27	7·934	2·057	5·877
„ 1894 „ 1895	3789	26	4	24	28	7·390	1·058	6·332
„ 1895 „ 1896	4160	22	7	16	23	5·529	1·682	3·847
„ 1896 „ 1897	4303	36	7	31	38	8·831	1·627	7·204
„ 1897 „ 1898	5530	36	13	33	46	8·318	2·351	5·967
„ 1898 „ 1899	6180	35	9	34	43	6·957	1·456	5·501
„ 1899 „ 1900	6834	19	7	16	23	3·365	1·024	2·341
„ 1900 „ 1901	7017	29	8	23	31	4·417	1·140	3·278
„ 1901 „ 1902	6438	38	7	35	42	6·524	1·088	5·437
„ 1902 „ 1903	6484	44	6	43	49	7·557	0·925	6·632
„ 1903, to 31 Dec., 1903	5604	27	8	20	28	4·977	1·428	3·569
1 Jan., 1904 „ 1904	6192	73	9	65	74	11·951	1·454	10·497
„ 1905 „ 1905	6586	34	7	30	37	5·618	1·063	4·555
„ 1906 „ 1906	7004	65	4	61	65	9·280	0·571	8·709
„ 1907 „ 1907	7516	68	6	64	70	9·314	0·798	8·515
„ 1908 „ 1908	6464	60	6	58	64	9·900	0·928	8·972

Diagram showing the ratio of fatal accidents in mines in Tasmania.

Rate per 1000 men employed.

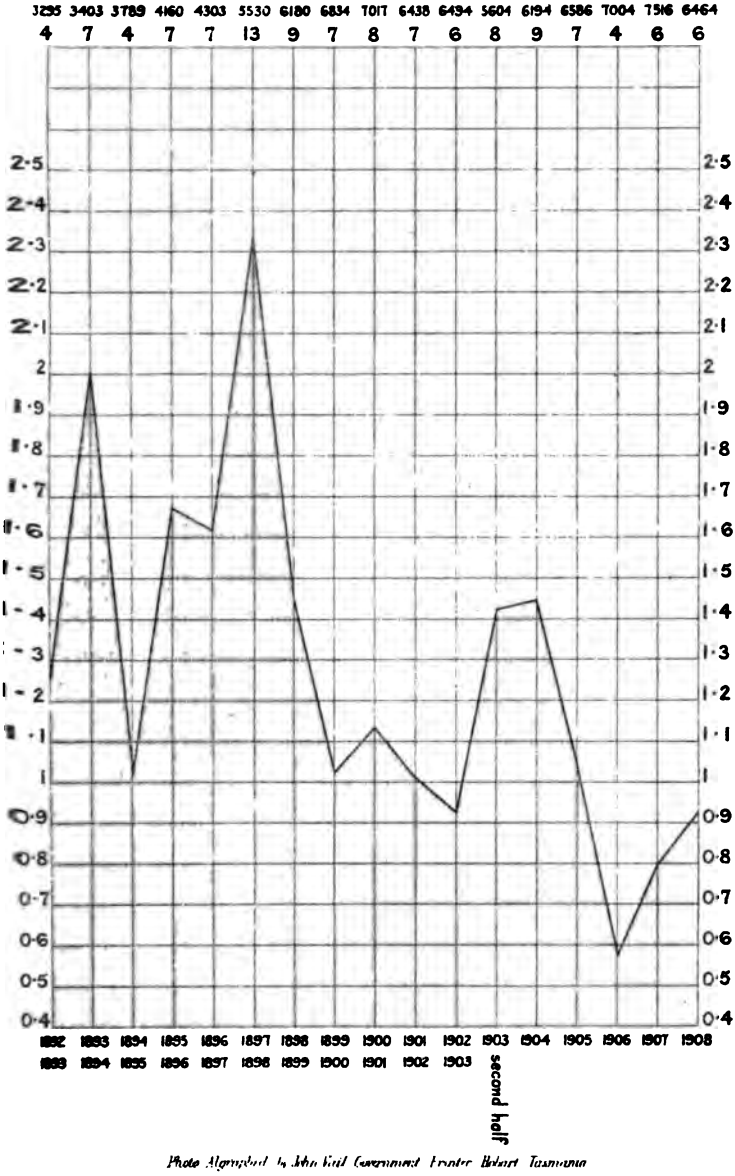


Photo Algraphed by John Vail Government Printer Hobart Tasmania

Division.	Average Number of Men employed.	Number of Accidents.	Number of Persons.		Total number Killed & Injured.	Average per 1000 Killed and Injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
Northern and Southern	803	16	Nil	16	16	19·925	Nil	19·925
North-Eastern	760	5	Nil	5	5	6·578	Nil	6·578
Eastern	583	4	Nil	4	4	6·861	Nil	6·861
North-Western	517	2	Nil	2	2	3·868	Nil	3·868
Western	3801	33	6	31	37	9·734	1·578	8·155
	6464	60	6	58	64	...	...	...

ANALYSIS of Statistics for the Western Division.

Division.	Average Number of Men employed.	Number of Accidents.	Number of Persons.		Total Number Killed & Injured.	Average per 1000 Killed and Injured.	Average per 1000.	
			Killed.	Injured.			Killed.	Injured.
Mount Lyell	2073	19	5	16	21	10·130	2·411	7·718
Zeehan, &c.	1728	14	1	15	16	9·259	0·578	8·680
	3801	33	6	31	37	9·734	1·578	8·155

TABLE showing the Numver of Persons Killed and Injured in and about the Mines of Tasmania during the Year 1908.

Place or Cause of Accident.	Inspection Districts.													
	Northern and Southern Division.		North-Eastern Division.		Eastern Division.		North-Western Division.		Western Division.				Total.	
									Zeehan and other Districts.		Lyell District.			
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Underground—														
Falls of Ground	...	4	...	...	...	...	...	...	...	2	2	2	2	8
Shaft Accidents—														
Things falling down shafts	...	...	...	...	...	1	...	...	...	...	...	...	...	1
Haulage	...	1	...	...	...	...	...	1	...	1	1	...	1	3
Falling down passes and shafts.....	...	...	...	...	...	...	...	...	...	...	...	2	...	2
Total	...	1	...	...	...	1	...	1	...	1	1	2	1	6

Miscellaneous (underground).														
Haulage—														
Trams, &c.	...	2	...	...	...	...	...	...	...	...	...	...	...	2
Sundry accidents	...	4	...	...	...	2	...	...	...	2	...	1	...	9
Explosives	...	...	...	...	...	...	...	...	...	3	...	2	...	5
Total	...	6	...	...	...	2	...	...	...	5	...	3	...	16
Total Underground	...	11	...	...	...	3	...	1	...	8	3	7	3	30
ON SURFACE—														
Smelting-works	...	...	...	...	...	...	...	...	1	4	...	1	1	5
Machinery	...	...	...	1	...	...	...	...	...	1	...	...	...	2
Falls of stone	...	...	...	...	...	...	...	...	...	...	...	1	...	1
Tramways	...	1	...	...	...	1	...	...	...	...	...	1	...	3
Falls of persons	...	2	...	2	...	...	...	...	...	...	2	4	2	8
Falls of timber	...	1	...	1	...	...	...	...	...	...	...	...	...	2
Miscellaneous—	...	1	...	1	...	...	...	1	...	2	...	2	...	7
Total Surface	...	5	...	5	...	1	...	1	...	7	2	9	3	28
GROSS TOTAL, 1908	...	16	...	5	...	4	...	2	1	15	5	16	6	58
Total during 1907	1	16	3	2	...	3	...	7	2	14	1	22	6	64

RETURN showing the Number of Men Killed and Injured in Mining Accidents during the Year 1908.

	Killed.	Injured.	Total.
Europeans	6	58	64
Chinese	...	...	...
	6	58	64

REPORTS OF INSPECTORS OF MINES.

MR. INSPECTOR GRIFFIN (Launceston) reports:—

I have the honour to submit my annual report as Inspector for the Northern and Southern, North-Eastern, and Eastern Divisions of the State for the year ending 31st December, 1908.

Accidents.—I am pleased to be able to state that no fatal accidents have occurred in the mines of the above divisions during the year. Twenty-five accidents of a nature serious enough to be recorded have been reported; of these, 11 were on the surface, and 14 underground. Although some of these accidents were of a very painful nature, causing the sufferer to be off work for several weeks, yet none of them were of a nature from which fatal results or permanent injury might be anticipated. No accident from the use of explosives occurred. In the majority of cases the injuries were cuts on head, jammed fingers, or a bruised foot, caused generally by small pieces of stone falling in stopes, trucks leaving the line, &c. Four-fifths of the whole number were what might be called purely accidental; some carelessness was perhaps in evidence, but nothing of a gross nature. Of the remaining five, two occurred in stopes, caused by timber giving away, for which both management and men were to blame—the men, who were contractors, for not setting up and securing the timber properly, and the management for not insisting on more care being taken by these men, who, if employed on wages instead of contract, would be more careful. One of these stope accidents might easily have been attended with fatal results. The man injured in it had a most miraculous escape from death, being for a time buried up to the waist beneath a tangle of timber and mullock. Shock and a few cuts about the head were, however, the only injuries he sustained.

Airey, an engine-driver, got his fingers jammed off through carelessly placing his hand on the bed-plate near the crank-disc while the engine was in motion. Baker, a wood-stacker, was struck on the head and badly injured through going from under cover when firewood was being sent down a shoot. Maumill, engaged attending to pumps, got into a compartment where he had no right to go, and was jammed, but not seriously injured, by the inspection cage.

Machinery and other Accidents reported:—At the Tasmania Gold Mine a double-cage with two trucks of mullock on was being lowered at rate of 1500 feet per minute. Something went wrong, probably the door of one truck got unfastened, and swinging out caught the frame timber of shaft. Both trucks were thrown out of the cage, and striking timbers below the 600-feet level on each side of the shaft. One truck went through roof of cage and jammed in shaft; the other was upside down, and balanced on the crossbar of cage. The safety-grips worked, smashed their chains, and turned right round, the squeeze reducing the 8-inch Oregon skid to 4 inches at place where they first struck. The only sign in the engine-

house was a slight shake of the rope, as when shutting off steam with unbalanced cages. It was only when the cage reached the bottom, 1000-feet level, that it became known that anything unusual had happened. The softwood skids allowed the grippers to turn right round, thus rendering them useless. It is, however, extremely doubtful if any safety appliances known or in use in this State would have arrested a heavily-loaded cage descending at such a high rate of speed. New grippers, with a projecting lug to prevent them from turning completely round, are now being fitted to the cages.

At the Tasmanian Consols an over-wind took place, and the cage went to the poppet-head. The detaching-hook acted well, and no damage was done.

At the Arba Tin Mine an accident to one of the tanks on the haulage line happened, owing to the slipping of clips on the rope-cupping splice. The tank descended with great force beneath the sand-bins, but no great damage was done, as there was a good buffer of tree-ferns and sand-pack for it to strike.

On December 30 the western cage of Hart's Shaft, Tasmania Mine, when about 150 feet from the surface, caught a loose studdle, which jammed it; in consequence, the two ¼-inch bridle-chains carried away, and the rope was released. The cage was held up by the safety-grippers. When the cage was brought to the surface it was thoroughly examined, but found in good order. One link in hauling-chain was found defective. The rope was pulled into the shoe to the extent of 5 inches, and had to be reshod.

Complaints from Miners.—Written complaints were made by miners, and in each case received prompt attention. In two cases out of three reported there was just cause for complaint; these were from two of the small gold mines. In one case the mine manager, who was also engine-driver on one shift, was accused of carelessness when in charge of the engine, inasmuch as he allowed the cage, with three men on, to descend into the well, which, fortunately, had only a few feet of water in it, otherwise serious consequences might have followed. As it was, two of the men got a fright and a bit of a ducking. The third man stepped out on to the plat as the cage slowed down before it went into the well. There was some little excuse for this mistake, as the indicator-chain in the engine-house had stretched a bit. Other mistakes made, such as allowing the cage after ascending (with men on) some distance to run back, also over-winding on one occasion, were inexcusable. It was, however, not considered necessary to take any proceedings against the offender, a reprimand and caution being sufficient. The second complaint was with reference to the unsafe method of working at another mine, where a tunnel was being driven through running ground. There was sufficient ground for this complaint, and the methods of working had to be improved upon. The third complaint made was in connection with what was alleged to be the very unsafe state of the workings of one of the small coal mines. A long journey had to be made to investigate this, and it was found that there were absolutely no grounds for the complaint.

Ventilation of Mines.—On the whole the ventilation of the metalliferous mines has been fairly good. In most cases natural ventilation is sufficient. Some few, however, have to

employ mechanical means, not regularly, but as a stand-by when natural means fail through atmospheric influences. At Beaconsfield, which is probably the worst district for gases, especially carbon dioxide, which is contained in large quantities in the rock strata penetrated, exhaust-fans are employed when natural ventilation fails through a change in the weather. High temperatures accompanied by a north wind are always a source of trouble, and the fan must be set going. At the big mine (Tasmania) natural ventilation, except at the north section, is found adequate, excepting at times when there is a sudden increase of water, which brings with it volumes of gas. This often occurs when the bottom levels are being driven, and a round of shots fired liberates both gas and water. The face must be then allowed to drain for several days. At the north section, where only a few men are employed, prospecting, a powerful fan is employed; but even this, with a good return air-course and brattice divisions right up to the face, is at times insufficient, and the men have to be called out and put to other work for a time. At the Bonanza Gold Mine the shaft-sinking was carried out to a depth of 1180 feet without encountering any difficulty in the way of gases. Now, however, that crosscutting and driving in the bottom carbonaceous strata has been started, the use of the blower is frequently needed.

Magazines.—The magazines at the different mines are well kept and in good order. A few pounds of gelignite which was badly stored and kept overlong had in one instance to be condemned. Apart from this, the explosives used were in good order.

Equipment.—The ropes, chains, shackles, and safety appliances in use are generally in good order and efficient, especially so at the big mines, where weekly all-round inspection, changing, or renewing is the order. With regard to the efficiency of safety-cage appliances, the two cage accidents at the Tasmania Mine already referred to under heading of machinery accidents. afford an object-lesson. In the one case the cage, loaded with two trucks of mullock and descending at the rate of 1500 feet per minute, was partly arrested through one of the trucks slipping out and striking the shaft timbers. This was sufficient to allow a slackening of the hauling-rope. The grippers acted, but so great was the force of the descending weight that they compressed the softwood skids, 8 by 4 Oregon, to half their size, turned completely round. and having passed their greatest eccentric radius were, of course, useless, and the cage was not stopped. In the other case the cage was ascending, when it was caught by the bottom end of a studdle swinging out an inch or two; the bridle-chains carried away, releasing the rope, but the cage was prevented from falling by the safety-grippers, which acted promptly as soon as the rope-connection was severed. The studdle did not jam the cage in any way, but striking as it did, end on, tended to force it downwards. The deduction to be drawn is that, as in the first case, the safety appliances cannot be depended on to arrest a loaded cage descending at a high rate of speed; even if the skids were of hardwood and no squeezing took place, something would be bound to give away and disable the grippers under the influence of such force. The winding-speed was, of course,

much higher, nearly three times as great as that allowed with men on, but still there must be some doubt as to the safety and usefulness of these grippers on a descending cage although they may be thoroughly relied on when the cage is moving upwards, as shown in the case of No. 2 accident.

Coal Mines.—The two principal collieries, Cornwall and Mt. Nicholas, maintained their usual outputs, although both have had to encounter difficulties of a serious nature through the faulting of the seams being worked.

Mt. Nicholas.—At this colliery the system of working is long-wall. The 4-feet seam worked for many years past gave out, or had to be abandoned, a year ago, owing to frequent faulting, that rendered working on long-wall, or indeed on any other system, difficult and unprofitable. Faulting of the seams in the Mt. Nicholas Range had to be counted with throughout the whole period of their working existence. Main faults, some times a down-throw of from 6 to 11 feet, and again jumps of a similar nature, but not so frequent as the down-throws, were in evidence from the first; these, however, only occurred at long intervals, and a good scope on even floor was worked between. It was not until the workings were pushed beneath the hill for a distance of three-quarters of a mile or so from the outcrop of the coal that serious difficulties were encountered. Minor faults appeared, and the floor became very uneven. The continuity of the long-wall face could not be maintained in unbroken line, and ventilation was a good deal interrupted. At last a jump-up fault occurred, cut off the seam completely, and beyond hope of being recovered again from the old working level. A rise was put up to a height of 32 feet, but the top was not reached. The break is in steps of from 10 to 12 feet each. The 4-feet seam is tilted up, but feathered, and disappears at the top of the first rise of 10 feet. A 5-feet seam of inferior coal above the 4-feet is also tilted up, but not lost sight of at the top of the rise. The line of fault is roughly north and south. No sign of the eruptive diabase rock was observed, nor was there any deterioration in the quality of the coal that would indicate its immediate proximity. A year's work in the 4-feet seam still remained in coming back south and east along the main line of faulting. In the meantime the 6-feet seam, on which some work was done a few years back, was reopened for a long-wall working. It had previously been worked on the pillar and bord, and now at the close of 1908 the whole of the coal output is being obtained from this seam. Difficulties had to be overcome. The thickness (6 feet) of the seam necessitated extra precautions in stowing, and large quantities of timber had to be used in packs on chocks, as well as in props and lids, to guard against a too sudden subsidence of the roof. Despite all this, a general crush took place in June last, and the colliery was idle for several days before work could be resumed. The area affected extended over 3 to 4 acres of worked-out seam. On resuming work it was thought advisable to work only the bottom portion, 4 feet 6 inches, of the seam, leaving 18 inches of coal and bands at the top, that makes an excellent roof. The subsidence although causing a good deal of work in the way of reopening roads, &c., had its value in easing the strain on the roof, and work is now proceeding in

a satisfactory manner. A continuous line of long-wall face is opened up, ventilation is good, and from an inspector's point of view the colliery was never in better nor safer working order than at present.

Cornwall Colliery.—The system of working in this colliery was, until the latter end of 1907, pillar and bord, when it was changed to long-wall. Why it was not worked from the first on the long-wall system is not easy to understand. The seam is 4 feet. Faulting, which at the commencement gave some trouble, had almost totally disappeared by the time the long-wall face was opened up, and for nearly a year everything went well under this system of working. The output of coal was increased, until it reached 10,483 tons for the quarter ending 30th September. The long-wall workings had opened out well, but faulting of the seam was soon encountered, and within a month this portion of the 4-feet seam had to be abandoned altogether, a network of faults having completely broken up the coal. The distance from the entrance of the tunnel to the point where work ceased is a little over three-quarters of a mile. A new pit was opened on a 5-feet seam 25 feet or so below the level of the abandoned 4-feet. The work was carried on for a month or two prior to the end of the year. During the Christmas holidays and when the mine had been idle for nine or 10 days a collapse of the roof took place in most of the working places, as well as in the back roads and main heading. So serious was the break that no attempt at reopening was made. The coal in this seam is of inferior quality. It could not be worked under the long-wall system, as the roof is bad, and as pillar and bord working is a more expensive method, there was no great incentive for reopening. Work is now in the old pit, recovering the coal pillars left from the first working on the pillar and bord system. There is also a good portion of the unbroken seam coming back towards the outcrop that can be worked. A small electric fan was installed during the year, and by this means ventilation was improved.

Wallsend Colliery (late Sandfly).—This colliery was reopened by a new company about the middle of the year. Mr. R. H. Stokes, late of Stockton Colliery, Newcastle, N.S.W., was appointed as mine manager. Extensive alterations and improvements have been made, and the mine is now being opened up in a thorough and systematic way for long-wall working. Mr. Stokes is a thoroughly experienced coalminer and the holder of a first-class certificate for mine management from New South Wales. It is safe to assume that if the Sandfly seam can be made to pay for working, he will make a success of it.

Mt. Cygnet Colliery.—No alteration to note in the working of this mine. Only two or three men employed, and the output seldom exceeds 300 tons per quarter. Berry's, Woodbridge, seam has been idle for some time past. Nothing doing at the Catamaran coal seam at Recherche Bay. It seems a pity that this coal never got a fair trial, as the seam is of good thickness, and the quality of the coal is quite equal, if not superior, to any coal worked in the State.

York Plains Coal Mine is still being worked in a small way. There is not much demand for this coal, which is only used by brewers and maltsters.

Mersey Coal.—Only Mr. Allison's Spreyton Mine working in the locality now. A new seam, or new workings, have been opened up about 1¼ mile east of the old colliery, and close to the Tarleton railway-station. The seam is probably the same as that worked at the old pit. No work is being done at the latter place now. Bound's Illamatha Coal Mine is idle. At Dulverton nothing in the way of coal-mining has been done for the past year or two.

Gold Mining.—Beaconsfield.—The Bonanza Company's shaft has been sunk to a total depth of 1180 feet. The bottom plat is cut at 1170 feet, from which level a short crosscut reached the continuation of the Tasmania Company's lode into Bonanza ground. Unfortunately for the Bonanza Company, the lode is not payable where cut. This bottom level in the Bonanza corresponds to the 1000-feet level in the Tasmania Mine. No great distance need be driven to connect the two mines.

Tasmania Gold Mine.—During the year the 1100-feet and also the 1250-feet levels have been connected with Hart's shaft, so that the lode can now be reached at these bottom levels from either Hart's or Grubb's shafts. Extra water was cut in driving west at the 100-feet level. At end of last year work was discontinued in that direction. A couple of months later, January, 1908, heavy water was cut in the 1100-feet level west, completely draining the 1000-feet level, and it was not considered advisable to continue driving until a connection was made between the 1250-feet level and Hart's shaft, as any excess of water could not be dealt with till this was done. Grubb's shaft was sunk a further distance of 76 feet, making a total depth of 1353 feet. Hart's shaft has not been sunk during the year, owing to the heavy flow of water. It will now be connected by rising from the bottom level. The sinking of Grubb's shaft towards the 1500-feet level will also be proceeded with. The pumps have easily controlled the water, the heaviest flow on any one day being 4,894,700 gallons. The mine is well equipped with regard to safety of working, and good ventilation is generally maintained.

Lefroy Field.—Blue Jacket.—This got another trial during the year, but the result was not satisfactory, and operations ceased.

The New Pinafore Company has done a good deal of prospecting. Nothing worth mentioning was discovered. Other parties have been at work, and on the whole a good deal of prospecting has been done.

Mathinna.—New Golden Gate Mine.—In the early part of the year the east lode at the 1800-feet level was driven on north and south from the crosscut. Going south stone giving fair prospects of gold was met with at one place, but the shoot was very short. A winze sunk 102 feet at this place lost the shoot further on, and before the main slide was reached the lode split up. A crosscut was driven east at this place for some little distance, but no good results followed. At the west lode some good payable stone was cut in driving north from the crosscut, but, as in the case of the eastern lode, the gold shoot was very short. A winze was sunk to a depth of 90 feet, but the gold did not live down. The mine has been tested to a total depth of 1902 feet. The bottom levels are now abandoned altogether. At the old upper levels, 500, 600, and

800 feet, short sections of stone are being worked by tribute parties, and good payable stone is obtained. The company is testing a lode on the old East Gate section. A shaft 12 feet by 4 feet was sunk to a depth of 200 feet, and the lode is being driven on.

Tasmanian Consols.—Work during the first part of the year was at the 1300, 1400, and 1500 feet levels. At the bottom (1600-feet) level the diamond-drill was employed, to test the western lode at greater depth. By arrangement the company was enabled to further test the west lode below the 1600-feet, by driving from the crosscut on the same lode in New Golden Gate Mine at the 1800-feet level. The distance to the boundary is about 200 feet. The drive was extended another 100 feet or so into the Consols' ground, but the lode so far tested was not payable. The last of the payable stone at the working levels was taken out, and the mine finally shut down about September.

Miner's Dream.—The Tasmanian Consols Company prospected this mine under option to purchase. A small winding plant was installed, and the underlay shaft going down on the lode deepened, making a total depth on the underlay of nearly 200 feet. The section of stone, when tested, on both sides of the shaft at bottom level was found to be short. Work had ceased before the end of the year, as the company declined to purchase under the terms of the option. The original owners, Stephenson and Dick, having become possessed of the winding plant under the terms of the option, will probably now work the mine themselves.

Eldorado Prospecting Syndicate made an attempt to reopen the old mine. A vertical boiler and small steam winch of the type used for pile-driving was put in use, and the old shaft (9 feet 8 inches by 3 feet 8 inches), which is 171 feet in depth, was unwatered. Some further work was done in the way of cleaning out the old crosscut, but operations soon came to an end.

Scott and Pickett Company.—This mine closed down during the year.

Golden Horseshoe Company.—At this mine there is a small crushing-plant driven by water-power. Stone was obtained by stoping from two windlass shafts, of depths from 80 to 100 feet. The equipment was not good. Altogether it was a sort of struggle for existence affair. It is understood that an effort to get more capital into this show will be made.

The Long Struggle Mine was under option to the Tasmanian Consols Company, but nothing has come of this.

Golconda.—The New Wyengatta.—The shaft has been sunk to a further depth, and is now down 257 feet from the surface. The lode at the bottom level is small and difficult to follow, owing to the hard nature of the country. The prospects of this mine were not very good at the close of the year.

Golden Pyramid Mine.—Several vain attempts have been made to reach a lode supposed to exist somewhere about the contact of the granite and sandstone, west of Panama Creek, by means of tunnelling. A shaft equipped with a small sinking-pump could have been put down to prove the existence or otherwise of the lode at much less cost than all this driving has run into.

New Panama Gold Mine.—This mine is still working and getting out stone. The ore is, however, of a complex nature, containing gold, galena, and silver. The Government expended a sum of money in extending the road from Golconda railway-station on to this mine. The whole distance is only 1½ mile. The company has now a fairly good road to its mine, but no ore has, so far, been sent out, excepting a few tons to the Pinafore battery at Lefroy.

Lisle Alluvial Gold.—About 20 men are at work on this old field; some few are prospecting and fossicking, the remainder working in open-cut on the terraces and in the old creek and flat workings. Most of these people have been on the field ever since it was discovered and worked so successfully 30 years ago. There is no impoverished look about place or people, and the conclusion one arrives at is that the small community is doing fairly well; in fact, much better than it cares to admit. The Tasmanian Consols (Mathinna) had some boring done on the flat with a view to working by bucket-dredge, but the results it is understood, were not satisfactory.

Tin Mines.—Every mine on the East and North-East Coast has suffered more or less from the effects of an exceptionally dry year—no rainfall worth mentioning. Many of the small claims, especially those depending on storm-water for their supply, suffered severely. In the Mt. Cameron district miners who were accustomed to get sufficient storm-water to keep their sluices going for from six to seven months in each year did not get as many weeks during the past year. The big mines, too, had to slow down. The Briseis, with its various sources of supply and extensive service channels, went short for a time, and had to discontinue the work of removing the overburden at its northern section for awhile. The Arba Tin Mine was practically idle for a long time. The Briseis Extended Company gets its supply by gravitation from the river close by. The breaking down water is pumped into the face from the barge, on which the centrifugal gravel-pump is at work. Its supply did not therefore diminish much. The Purdue Tin Mine, near Gladstone, is perhaps the only tin mine that can claim to have worked full time throughout the year. Its steam-pumping plant, 3-stage centrifugal with Allen engines, is up to date, and gives a highly efficient service, pumping under a head pressure of 300 feet. The power-station is 30 feet above river-level the water being brought on to the pump-well by open race from the river. This plan insures immunity from interference by floods, and also affords a means of getting rid of a great proportion of the tailing sand before the water reaches the pump.

Pioneer Tin Mine.—Shortage of water interfered a good deal with the progress of this mine towards the close of the year. The hydro-electric scheme now fast approaching completion will not only cheapen and otherwise facilitate the use of mechanical power required for running the gravel-pump, but also ensure a more constant supply of water for sluicing purposes. Through the courtesy of the general manager, Mr. C. G. Ryan, I am enabled to furnish the following outline of the new scheme:—

The primary object was to augment the water-supply by the construction of a dam on the Frome River that would enable

enough water to be stored to run the sluicing plants continuously during the summer months. As the elevation of the dam above the mine workings was sufficient to give the necessary power for generating electricity for driving two large barges, it was decided to put in a generating station at a convenient point, and substitute motors for driving the sand-pump in the place of steam-engines. The water therefore serves the dual purpose of providing water-power for the pumps, and water for sluicing. The dam is 625 feet in length and 54 feet in depth, and is constructed of loose rock with a concrete facing, and has a capacity, to the 51-feet level, of 420,000,000 gallons. The water is drawn off in a concrete tunnel through the base of the dam, and passes into a race 1¼ mile in length, which conveys it to the head of the power-pipe line of wrought-iron, 36 inches in diameter and 1200 feet in length, from the end of which it issues to the nozzles, driving the turbines under a head of 440 feet. Three generating sets are installed of Voith turbines, coupled direct to 375 K.W. Allgemeine. Three-phase generators, generating at 6500 volts, which is transmitted 4 miles to the mine, direct on to the motors driving the sand-bumps. From the turbines the water passes into a race 3 miles long, which conveys it to the head of the pressure-column on the mine, from which it issues from the sluicing-nozzles under a head of 250 feet. The transmission line is carried to the edge of the workings, where it branches in two, each branch consisting of armoured cable, which is carried on to the two barges, each of which has a 400 B.H.P. motor driving a 16-inch sand-pump. The priming gear, consisting of an Edwards air-pump, is directly connected to a 5 B.H.P. motor. The speed variation on the motor is obtained by a liquid controller, and also by different sized split-pulleys on the motor shaft. The whole outfit combines the most modern European practice, and is fitted with carriage-switch gear and automatic voltage regulation, as well as lightning arrestors and other safety devices. It is anticipated that the plant will be in operation before the end of April, 1909.

The Anchor Tin Mine ceased operations for a time towards the end of the year. Want of a sufficient supply of water was mainly the cause of this, as it is only by treating large quantities that the mine has any chance of living at all.

The Mt. Rex Company commenced again, this time on a big lode formation to the south-east of the old mine. Several hundred tons were put through, but the lode-stuff could not be made to yield marketable tin, owing to the presence of large quantities of wolfram.

The Shepherd and Murphy Mine at Bell Mount.—Middlesex is working steadily, and with a fair measure of success. Scarcity of water here, as elsewhere, retarded operations a good deal. The mill and concentrating plant is operated by Pelton wheels. A crosscut, which is a continuation of the battery level tunnel tapping No. 6 lode is now being driven south. The intention is to cut all the lodes hitherto worked from the higher level tunnels, and do away with the necessity for using the aerial tram.

Silver Mines.—The Round Hill Silver and Lead Mining Company had almost completed its ore-concentrating plant at the close of the year. No mining work had been done during the last quarter, but everything is in readiness for the breaking

of large quantities of ore, once the plant for treating it is set going. The facilities for mining by means of tunnelling are excellent, and with plenty of ore in sight good results might reasonably be expected.

Devon Silver Mine.—Work was resumed after the winter months were over, and about 50 tons of high-grade ore obtained from the old adit level. A winze commenced at the end of the year is going down on good ore, the lode improving in width as sinking proceeds. Only a few men, seven in all, are employed. The means of transit of the ore from this mine to Devonport has been made easier by the opening of the new road from South Staverton *viâ* the Round Hill Silver and Lead Mine to Lorinna on the River Forth, a distance of 10 miles. The ore has still to be packed from the mine to Lorinna, about 5 miles. The new route is shorter by about 5 miles than the old road *viâ* the Shepherd and Murphy Mine and Wilmot.

Copper.—Burnie Copper Mine.—The old company ceased operations altogether in September, and sold its leases and plant to a small syndicate formed at Burnie, which has taken out a considerable quantity of ore left in the different levels. This work will soon come to an end, and it is not likely that any attempt will be made, by the present owners at all events, to prove the lode to a greater depth. The total depth worked to is 258 feet. The shoot of ore shortened going south at the bottom level, and the lode pinched somewhat under foot.

Copper Creek Syndicate.—Gunn's Plains.—No work at this mine since February, 1908.

Bucket-dredging for Tin.—The Gladstone Development Company's dredge has been idle for several months past. All the payable ground in "Weir's" paddock being worked out, it will be necessary to remove the dredge to a flat about half a mile further down the river. This can only be accomplished in time of flood, or by constructing a temporary dam to raise the water. The Dorset and Ringarooma dredges are working with varied success. There is now a chance of improvement under new management.

Annexed are tables showing the number and nature of accidents for the year.

Fatal, 0 ; non-fatal, 25 ; total, 25.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1908.							
23 Jan.	Tasmania Gold Mining Co., Ltd.	Beaconsfield	Piece slipping from chuck of lathe	Archer, Edward	Married	Right forearm badly lacerated	Was preparing to turn up matching piece in lathe of fitting shop ; piece fell out of chuck, when machine started ; caught his arm on tool rest.
24 Jan.	South Mount Cameron Tin Mining Co.	South Mt. Cameron	Inadvertently placing hand on bed plate of engine, caught by crank disc	Airey, Joseph	Single	Points of first and second fingers of right hand cut off	Was employed as engine-driver ; inadvertantly placed his hand on bed plate, was caught by disc crank of engine and had his finger tops cut off.
25 Jan.	Tasmania Gold Mining Co., Ltd.	Beaconsfield	Truck jumping tram rails	Oakley, Henry	Ditto	Flesh torn from knuckles and palm of hand	Was trucking at 1100-ft. level ; truck jumped rails, and jammed his hand against a leg, tearing the flesh from knuckles and palm.
30 Jan.	Ditto	Ditto	Ground falling from hanging wall	Foley, James	Married	Cut on head	While shovelling quartz in stope of Block 152, loosened baulked ground in hanging wall, portion came away, striking him on the head, and inflicting a wound 2½ inches long.
18 Feb.	Purdue Tin Mining Co.	Gladstone	Adze slipping	Arnold, Arthur	Ditto	Severe cut on foot	Was carpentering, axe slipped, cutting his foot badly ; was off work 20 days as result of accident.

LIST of Accidents in Inspector Griffin's District for Year 1908—continued.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1908.							
2 Mar.	Shepherd & Murphy Mining Syndicate	Middlesex	Slipped off lath into pass, fell 10 or 12 feet	Johnstone, Arthur	Married	Slight cut on head and severe injury to leg below knee	Was sending mullock down pass from surface, slipped on lath, and fell down pass, some 10 or 12 feet, sustaining cut on head and severe injury to leg.
9 Mar.	New Golden Gate G.M. Co	Mathinna	Stage giving way	Summers, Thos.	Ditto	Bruised side; appeared to have a rib broken	Had, with his mate, John Long, fixed up a stage in a stope to beat off a blow; the stage gave way, and Summers fell 7 feet; got his side rather badly bruised.
25 Mar.	Anchor Tin Mine	Lottah	Knocked down by rake of trucks	Steel, Ray F.	Ditto	Foot badly crushed	Was fixing something at battery hopper, and standing close to rails of tram, did not hear warning whistle from rake of trucks coming in; was knocked down, one truck passing over his foot, and crushing it.
25 April	Tasmania Gold Mining Co., Ltd.	Beaconsfield	Screen blown against him	Hutchins, Wm.	Ditto	Severe shock	Was dismantling hydraulic filter, wind blew a screen against him causing him to fall about 8 feet; he was insensible for a few minutes, suffered from shock, and was off work for 7 weeks.
4 May	Ditto	Ditto	Timber he was handling falling on his foot	Garrett, James	Ditto	Big toe badly bruised and lacerated	Was handling a piece of timber for main shaft; it slipped, and falling, caught his foot, bruising and lacerating the great toe

							weeks on work as a result of this accident.
5 June	Ditto	Ditto	Cap slipping from footwall hitch	Campbell, Alexander	Ditto	Cuts on face and severe shaking	While stoping in No. 7 Block, stepped on cap which carried away from footwall hitch; he fell 15 feet, and sustained several cuts on face, also very severe shaking.
1 Aug.	Tasmania Gold Mining Co., Ltd.	Beaconsfield	Caught by descending cage	Maumill, E. A.	Ditto	Squeezed about hips, left foot a little strained	Was attending to pet cocks of plungers, was caught by inspection cage which was being lowered slowly, got a good squeeze across the buttocks and hips, also injury to left foot which was strained.
26 Aug.	Briseis Tin Mines, Ltd.	Derby	Reaching for piece of board and overbalanced	Chick, Arthur John	Ditto	Shoulder dislocated	Was reaching over dump race at open cut face, lost his balance, and fell 6 feet, dislocating his shoulder joint; was off work 5 weeks as a result of this accident.
26 Aug.	Tasmania Gold Mining Co., Ltd.	Beaconsfield	Run into by a truck being wheeled by another man	Lock, Henry	Ditto	Bruised on ribs under right arm	Was cleaning road underground, when his mate coming along with a truck jammed him against the wall; he received a bruise on the ribs under the right arm; was off work 3 weeks as a result of accident.
24 Sept.	Briesis Tin Mines, Ltd.	Derby	Fall from stage	Wilkins, Arthur Henry	Ditto	Blow on head, causing unconsciousness for a short time	While working on a stage 7 feet high, he got his file fast in a hole being drilled through galvanized iron, and in endeavouring to free it, lost his balance, and fell to the floor, striking his head.

LIST of Accidents in Inspector Griffin's District for Year 1908—continued.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1908							
22 Sept.	Tasmania Gold Mining Co., Ltd.	Beaconsfield	Jumping off rake of trucks while in motion.	Herron, George	Married	Leg badly bruised, no bones broken	While jumping off a rake of trucks slipped and fell, one truck running over his leg before horse could be stopped; fortunately no bones were broken.
1 Oct.	New Golden Gate G.M. Co.	Mathinna	Windlass handle slipped	Moses, F.	Widower	Deep gash in forehead	Was hoisting a full bucket of dirt out of winze; windlass handle slipped from his hands, and striking him on the forehead inflicted a deep gash.
8 Oct.	Pioneer Tin Mining Co.	Bradshaw's Creek	Carelessly going too near firewood chute	Barker, Walter	Married	Severe scalp wound	Was engaged stacking enginewood, carelessly went from under cover when wood was sliding down chute, was struck on the head by a piece, and temporarily rendered unconscious.
14 Oct.	Tasmania Gold Mining Co., Ltd.	Beaconsfield	Piece of stone falling from hanging wall	Brown. J. W.	Ditto	Cut on head severing an artery	While working in stope, No. 9 Block, a piece of stone fell from hanging wall, striking him on the head and cutting an artery; he was off work 3 weeks.
3 Nov.	Ditto	Ditto	Stone rolling down rill	Foley, William	Single	Cut on head	While working in Block 201 was struck on the head by a piece of stone that rolled down rill; injury not very serious; he was off work 3 weeks.

			hole of staging				platform, he fell over, breaking his leg ; not a bad fracture.
10 Dec.	Ditto	Ditto	Ground falling from hanging wall	Ashman, James	Ditto	Jammed fingers	A piece of ground fell out of hanging wall and jammed his fingers against a set of timber, breaking end joint of one.
16 Dec.	Ditto	Ditto	Timbers in stope giving way	Brown, William	Ditto	Severe shock and cut on head	One of a contract party working in Block 103, footwall hitch gave way letting down several sets of timber, Brown was buried up to his waist, and had a narrow escape of being killed ; his injuries, however, were not serious.
19 Dec.	New Golden Gate G.M. Co.	Mathinna	Pipe falling down shaft	Rushton, E.	Ditto	Foot badly bruised on instep, no bones broken	Was engaged as platman ; sent some pipes to surface in cage, securely lashed ; one dropped down shaft when braceman was removing them, and struck Rushton on the foot; braceman did not see pipe slip.

MR. INSPECTOR HARRISON (Zeehan) reports :—

Accidents.—In submitting my annual report for 1908, I beg to state that the number of mining accidents has been 13, and at the Tasmanian Smelters five, one of which proved fatal.

Ropes and Cages.—Ropes and cages have been tested, as required; several of the former have been replaced by new ones.

Ventilation.—The ventilation of the mines has been in most instances all that could be desired, and there have been no complaints.

Prospects of the Field.—Notwithstanding the depressed state of the metal market and the temporary closing down of the Tasmanian Smelters, the output from the field has been fairly well maintained. Smelters are in course of erection for the treatment of the large quantities of stannite ore that has been opened up in the Oonah Mine.

The construction of tracks and bridges is enabling the prospectors to extend their exertions further afield, and encouraging reports are coming in.

Magazines.—Magazines are 31 in number in this district, requiring supervision. They are kept in good order.

Legal Proceedings.—There have not been any during the year.

LIST of Accidents in Inspector Harrison's District for Year 1908.

Fatal, 1; non-fatal, 17; total, 18.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1908. 28 Feb.	Magnet Silver Mine	Magnet	Cage being moved without signal.	Cooper, Walter	Single	Cut heel	—
14 Mar.	Spray Mine	Zeehan	Fall of rock	Wyatt, George	Married	Injury to spine	While cutting hitch for log
17 Mar.	Hercules Mine	Mt. Read	Barring down	Monks, John Andrew	Ditto	Broken leg	While working down. Result of a shot
18 Mar.	No. 2 Magnet Mine	Zeehan	Explosion	M'Villy, Henry	Ditto	Burns and cuts on hands and body	In boring struck bottom of hole in which there was some unexploded gelignite
18 Mar.	Ditto	Ditto	Ditto	Evans, Thomas	Ditto	Ditto	
23 Mar.	Colebrook Mine	Dundas	Revolving of winch handle	Gannon, Patrick	Ditto	Fractured arm	Struck on arm by winch handle
11 Apr.	Tasmanian Smelters	Zeehan	Putting belt on wheel	Eberle, Daniel	Ditto	Broken Arm	Putting belt on wheel while in motion
25 May	N. Mt. Farrell Mine	Mt. Farrell	Explosion	Parsons, Robert	Single	Cut eye	Parsons was notified about a fire, but thought it was in another place
30 July	Oonah Mine	Zeehan	Loading trucks	Dakin, George	Married	Broken leg	Loading ore in trucks

LIST of Accidents in Inspector Harrison's District for Year 1908—continued.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1908.							
6 Aug.	Tasmanian Smelters	Zeehan	Putting belt on wheel	Sherrin, Horace	Single	Mangled arm	Putting belt on wheel while in motion
20 Aug.	North Mt. Farrell	Mt. Farrell	Fall of ground and timber	Curtin, Frank	Ditto	Crushed	In driving home laths, knocked the cap pieces off the legs
20 Aug.	Ditto	Ditto	Ditto	Jones, Robert	Ditto	Shock	
15 Sep.	Victoria-Zeehan Mine	Zeehan	Lowering of cage	Davis, Charles	Married	Shock	Engine driver lowered cage on him
28 Oct.	Tasmanian Smelters	Ditto	Caught in harness	Hines, William	Ditto	Broken arm	Horse driven on slag pot while cleaning tuyer of furnace
9 Nov.	Cleveland T.M. Coy.	Heazlewood	Trucking	Sims, William	Single	Ditto	Sims was trucking at the time
12 Nov.	Tasmanian Smelters	Zeehan	Explosion	Timothy, J.	Married	Burns on face	Explosion of gas
20 Nov.	New Mt Zeehan	Ditto	Putting belt on wheel	Gamble. Frank	Ditto	Broken arm	Putting on belt while wheel in motion
1 Dec.	Tasmanian Smelters	Ditto	Fall of slag	M'Phillips, J.	Single	Both legs broken	While working in slag dump a fall of slag occurred

MR. INSPECTOR CURTAIN (Queenstown) reports :—

Of the 21 casualties recorded, five were accompanied or followed by death. This, unfortunately, is the highest percentage on this field since it became a separate district.

1. Maher's thigh was broken by a fall of side rock while he, with his mate, was timbering a pass. In due time (six weeks) his convalescence was well assured, when a lung complication, arising from a clot of blood, whose origin was attributed to the mine injury, unexpectedly set in, and from which, briefly after its first symptom was observed, he expired. He was a capable man, and a statement supplied by him shortly after the occurrence pointed to the fact that it was purely accidental.

2 and 3. Atkinson and Cusick, with others, were late in the evening working overtime in one of the overburden benches of the open-cuts, in order to make it safe for the next morning-shift, when from some unaccountable cause both fell off the bench and lost their lives. At the coroner's enquiry it was surmised that Cusick, while barring down a piece of spoil, lost his balance, and Atkinson, realising his mate's danger, attempted to save him, but failed, and, instead, went with him. Subsequently it became generally stated that Atkinson suffered from dizziness or some other head trouble, and being evidently seized with an attack at the time, fell forward, and striking Cusick, who was a light man, occasioned the trouble.

4. Archie Frank Best, a platman at the North Lyell Mine, lost his life by being crushed by the cage against the shaft timbers. A mate was travelling with him, but beyond stating (1) that the deceased knocked the cage away prior to entering it (which was contrary to the mine's regulation), and (2) that ample time elapsed for Best to enter before the enginedriver moved it away after receiving Best's signal, he could give no tangible reason how the accident happened. Best's duties gave him control of the cage, and how he got entangled is a mystery.

5. David Young, a head contractor in the substopes of the 700 feet level at the North Lyell Mine, lost his life by a fall of face rock. From the statement of his mate it was quite evident both were aware of the "drummy nature" of the ground, but to "build" a pass directly alongside this same ground, "chanced it," with the result that such procedure added another victim to the many who have lost their lives from a similar cause.

Next in order to these fatal accidents may be taken that of Willows Farrows, who, following the pernicious practice of priming fuse by biting the caps on, had one explode in his mouth, which, in addition to shattering his jaws, burst an unsightly hole through his cheek, and otherwise severely injured his throat and tongue. For some time he remained in the local hospital, but to secure special treatment was removed to Melbourne, where, it is stated, he fared indifferently. His last address was with his relatives at Tunnack, but locally his state of health is unknown.

McNab, a slag wheeler at the Reduction Works, was severely burned by backing into a pot of molten metal, but fortunately he has made a remarkable recovery, and is again pursuing his ordinary labours at the works.

Cox, a machine hand, in broad daylight walked into a mullock pass at the Iron Blow open-cut workings, and was, with a broken shoulder and severe head wounds, unconscious for a week.

These, with Fisher, a carpenter, who fell off the roof at the Converters while making some alterations there, may be rated as the more serious injuries that have taken place during the year, the remainder being of a minor and non-apprehensive character, compare favourably with other States, when the number and occupations of the men are taken into consideration.

Of those not enumerated, a case of "gassing" took place on the eastern crosscut of the North Lyell Mines' 1000-feet level, where a man was overcome and seriously affected for some days afterwards. Here, again, unnecessary liberties were taken, redeemed only by the fact that the man's mate, though somewhat oppressed, stuck by his unconscious comrade and carried him outside the influence of the fumes, where, after raising the alarm, he practically collapsed himself.

Chiefly based on medical information, it is pleasing to state that, bar casuals from other places, the health generally of the men is good. This, however, should be expected, for, as a body, they are still in their prime, many really barely out of their teens. Hence, while fully recognising this fact, it was with no desire to harass those in charge that exception had to be taken to the quality of the air prevailing in certain ends, rises, and close stopes; together with dust from rock drills, and smoke from blasting; but to remedy these evils, in pursuance of the Mining Regulations, so that the evils arising from such causes, and so notoriously known in older fields, should not get a footing here.

Ropes and Cages.—These in use receive periodical inspection, and within the stipulated intervals are tested and minuted by the company's officers, whereby a departmental repetition is unnecessary. The ropes on the new electrical hoist at the North Lyell Mine are furnished with the maker's certificate, which states their quality and breaking strains as 30 tons.

Explosives and their Magazines.—These are satisfactory, taking into consideration the large quantities of chemical and mechanical compounds that pass into use in this district, the Mt. Lyell Company's consumption alone exceeding 60 tons.

Fatal, 5 ; non-fatal, 16 ; total, 21.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1908. 23 Jan.	Mt. Lyell M. and R. Co., Limited	Queenstown	Pot of molten slag left in thoroughfare	Geo. McNabb	Single	Severe burns to back, buttocks, and left arm	McNabb was slag-wheeler at No. 2 plant of the reduction works, and while attempting to place an empty pot under the spout of No. 9, backed unconsciously into another pot of molten slag that had just been withdrawn and left in the roadway by a fellow-wheeler. The injured man is again at work.
7 Feb.	Ditto	North Lyell	Fall of rock	James Maher	Married	Left thigh broken above knee	Maher was treated for sometime in the casualty ward at Gormanston, and subsequently left there for his home, where he continued to improve, but on the morning of the 23 d March he took suddenly ill and died, the cause being pulmonary embolism, attributable to relics of the accident.
7 Feb.	Ditto	Ditto	Ditto	Patrick Reilly	Single	Severely bruised on left side of face, shoulder, and leg	Reilly was Maher's mate, and observing the side coming away pushed him from under it, but was caught himself and pinned under the fall until assistance arrived and released him. He made a complete recovery.

LIST of Accidents in Inspector Curtain's District for the Year 1908—continued.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1908.							
11 Feb.	Mt. Lyell M. and R. Co., Ltd.	Gormanston	Fall over, and from No. 1 overburden bench	William Atkinson	Married, aged 47 years	Concussion of brain, severe scalp wounds, ribs and right arm broken	Atkinson, with others, was working overtime, and from some unaccountable cause fell over the bench, a distance of some 120 feet, and was killed.
11 Feb.	Ditto	Ditto	Ditto	William Cusick	Single, aged 28 years	Fractured skull and lacerated brain	Cusick was mate with Atkinson, both men being working together. It is believed Cusick fell first, but from what cause there was no evidence to show how it happened. Death ensued three days later.
18 Mar.	Ditto	Ditto	Fall down a surface mullock-pass	Robt. J. Cox	Single, aged 24 years	Concussion of brain and right collar-bone fractured	Cox, when returning from crib, in broad daylight, walked into the pass and fell about 40 feet. He was unconscious for some time, but he has made a good recovery.
31 Mar.	Ditto	North Lyell	Fell 40 feet through a timber-chute off a chain sling	John Thompson	Married, aged 33 years	Severe shaking and bruised body, but no bones broken	Thompson was assisting to land timber on the 5th floor of No. 14 stope workings, and while being hoisted to the next floor fell or slipped through the sling. He recovered and is working again.
2 April	Ditto	Ditto	Fall of rock in No. 15 winze	Benj. Krull	Married, aged 48 years	Severe bruises on back, loins, and side	Krull, with his mate, was engaged timbering when the piece came away. He recovered, and has resumed work.

			cap			of thumb and fingers	detonator it exploded. He has resumed work.
28 May	Ditto	Ditto	Jammed by a rising cage against the 850ft. level's plat-timbers	Archie Frank Best	Single, aged 31 years	Severely crushed about the head and shoulders	Best was platman, and, contrary to instructions, attempted to enter the cage after having signalled it away, with the result that he was caught and crushed to death.
2 June	Ditto	Gormanston	Slip back on aerial rope-way	Frederick H. Wright	Single, aged 32 years	Crushed left hand that necessitated amputation	Wright, as a coupler, while waiting at the mine-bins to despatch the next bucket, sustained the injuries stated, through the grip of the preceding bucket becoming disengaged from the haul or running rope. His condition and whereabouts are unknown.
9 June	Ditto	North Lyell	Premature explosion of dynamite cap while being bit on to fuse	Willows Farrow	Single, aged 29 years	Top and bottom jaws of left cheek fractured, with lacerated tongue, throat, and roof of mouth	Farrow was preparing a "round of charges," and to prime the fuses adopted the general but dangerous practice of biting the cap on to the fuse, with the foregoing stated result. He left the local hospital for treatment in Victoria, but his present condition and whereabouts are unknown.
12 June	Ditto	Gormanston	Jammed by a mullock-wagon against No. 1 bench-wall	Clyde Langdon	Single, aged 20 years	Bruised about groin, back, and abdomen	Langdon, after obtaining a place of safety, thoughtlessly left it, and sustained the injuries stated. They were not serious, and he early resumed work.

LIST of Accidents in Inspector Curtain's District for Year 1908—continued.

Date of Accident.	Name of Mine.	Locality.	Cause of Accident.	Name of Sufferer.	Married or Single.	Nature of Injuries.	Particulars.
1908. 13 June	Mt. Lyell M. and R. Co., Ltd.	Queenstown	While emptying a barrow fell over an embankment	Percy J. Butler	Single, aged 14 years	Right leg broken above ankle	Butler was employed as a "nipper" at the converting works, and while emptying a barrow it overbalanced, and he going with it, fell about 20 feet, and sustained the injuries herein stated. He is again working.
23 July	Ditto	North Lyell	Fall of ground from working face of substope at the 700-ft. level	David Young	Married, aged 31 years	Severely crushed across abdomen	Young was the leader of a large contracting party, and while engaged timbering an ore-chute a slab of schist that was known to himself to be "drummy" fell away, and killed him.
15 Aug.	Ditto	Queenstown	Fall from roof of converter's shed	James Fisher	Married, aged 45 years	Lacerated left eyebrow, bruises, and shock	Fisher, a carpenter, and others were engaged on the roof making some alterations when, stepping on the galvanised iron that had been rendered slippery by a heavy frost, he lost his balance and fell about 20 feet. He is again working.
4 Sept.	Ditto	Gormanston	Fell from II. to IIA. bench, a distance of 33 feet	William Garwood	Married, aged 28 years	Fractured olecranon or "funny bone" of elbow.	Garwood was raising the end of a sleeper with his "beater," and the latter slipping caused him to overbalance and fall as described. He left the district

			and un-covered pass		years	a general shaking	direction and fell down the manway leading to No. 14 stope. He returned to work on the 15th October.
21 Sept.	Ditto	Gormanston	While barring down a piece of pyritic ore, fell on crowbar man was using	John Quayle	Married, aged 28 years	Nose broken over bridge	Quayle, a member of an emergency gang, was retained after hours in order to make the workings safe, and while doing so, in a most peculiar manner, met with the accident as here described.
29 Sept.	Ditto	North Lyell	Fell down a mullock chute manway	William Joseph O'Brien	Single, aged 23 years	Dislocated left shoulder	O'Brien's duties necessitated his keeping the required mullock-chutes open, and while so engaged he fell off the timbers and sustained the injuries that incapacitated him for four weeks.
10 Oct.	Ditto	Gormanston	Struck by a piece of ore that came away from an upturned wagon	William Bushell	Single, aged 30 years	Shoulder and back bruised, that necessitated his removal to casualty ward	Bushell's chief duty was that of powder-monkey on bench IVc., but while performing other services a piece of ore that was shot out of a derailed or overturned truck from the bench above struck him. Pneumonia supervened, which made his case serious. He recovered and resumed work.

REPORT ON SHALE DEPOSITS IN TASMANIA.

1. *Tasmanite Shale.*—The oil shale of the Mersey district, which was formerly called dysodile, occurs associated with coal-measure sandstones in the Latrobe area in the basin of the River Mersey. It seems to have been recorded first in 1852, when it was reported to the Royal Society of Tasmania. The first analysis of it was made by Professor Penny, of Glasgow, who reported as follows :—

Resinous matter	26·04
Sand and clay	69·83
Pyrites	2·76
Water	1·37
	100·00

He also stated a proximate analysis as follows :—

Volatile matter	20·41
Fixed carbon	5·50
Ash	71·20
Sulphur	0·73
Water	2·16
	100·00

In 1861, Mr. Charles Gould reported officially that, the coal measure beds are permeated by the resinous particles of the substance, and he referred to this as dysodile; but Professor A. H. Church, in 1864, gave the shale the name of tasmanite.

In 1876, Mr. E. T. Newton proposed the name tasmanite for the shale, and Tasmanites punctatus for the spores (or plants to which they belong). The size and form of the seed-like bodies or sacs were considered by him to indicate that they are more nearly allied to Lycopodiaceous macrospores than to anything else.

E. A. Newell Arber (Catalogue of the Fossil Plants of the Glossopteris flora, Brit. Museum, p. 176) in 1905 regarded it as hardly necessary to retain the name Tasmanites punctatus. He says there is no doubt that they are of the nature of spores, although of what particular type of plant there is no evidence to show. They can, however, hardly be of Lycopodean origin, since lycopods are unknown at present from Australasia in association with the Glassopteris fauna.

The layers of shale wear the aspect of a light-brown or yellowish brown sandstone, charged with minute resinous-looking flattened discs. Marine Permo-Carboniferous fossils (Spirifera, Productus, Aviculopecten, Cardiamorpha, Pachydomus, Platyschima, Pleuretomaria, Pteronites) are recorded from the beds. They are just below the Tasmanian upper marine Permo-Carboniferous beds, and correspond approximately with the Mersey coal measures, though their precise relations with the

known coal seams in this basin have not yet been settled. The neighbouring coal seams probably lie beneath them.

The known shale area comprises a strip of country about 6 miles long by 2 miles wide, lying to the east of the railway-line, between Railton and Latrobe. One thousand three hundred and five acres of this are held at present for shale-mining, and 931 acres formerly held are at present vacant. About a square mile has been proved by shafts. At the southern end of the field, north of Railton, 899 acres are held in the name of F. E. Hedditch, where, apart from two small upper seams of inferior quality, a 4-ft. seam of good quality has been proved at a depth of 28 feet from the surface. At the northern end of the area, about a couple of miles south of Latrobe, 406 acres are held, in the name of G. T. Bastard.

The Mersey River has intersected the shale area, and at one place a bed shows in the bank for a thickness of 6 or 7 feet. An outcrop has also been noticed up to 9 feet in thickness. Several of the exposures are at different levels, and are considered to belong to more than one seam. At many points the beds can be worked by open-cut; and where underground mining is necessary, drainage will be easy, as the beds are higher than the river. It is probable that the area in which the shale beds occur is more extensive than is at present known. It is intended to have a departmental examination of the district made shortly.

In 1902 the Tasmanian Shale and Oil Syndicate, originating in South Australia, caused some exhaustive experiments to be made by Dr. J. G. A. Black, M.A., and Mr. T. Esdaile. The sulphur and refractory bitumens contained in the shale were removed in the experiments without difficulty, and were declared as forming no obstacle to the successful extraction of the oil. Dr. Black reported results from various outcrops as from 44 to 65 gallons of crude oil per ton. Mr. Esdaile says that the tests indicate an average richness of 60·2 gallons of oil per ton of shale, sp. gr. 0·931. He states that the specific gravity of the crude oil is about ·932, as against ·892 of the parallel oil of the Scotch shales.

The following tabular statement of oil products obtained by testing 144 ozs. (troy) of crude oil, equal to about 39¼ lbs. of good shale, by Esdaile's No. 2 method has been published, and will show the nature of the oils which can be extracted from the Mersey shale :—

Product.	Weight in troy, ozs. grs.	Fraction of gallon of product.	Temperature of steam distillation.	Specific gravity at 20 deg. Cent.	Flashing temperature, degrees Fahr	Firing temperature, degrees Fahr.	Gallons per ton of 2240 lbs.
Gasoline or heavy benzine ..	12·390	·1128	up to 115C.	·779	Fires at once	Ordinary temperature	6·429
Light burning oil (photogene)	12·270	·1115	up to 140C.	·834	88° F.	120° F.	6·355
Heavy burning or lighthouse oil	6·600	·0496	140 to 160C	·846	140° F.	161° F.	2·827
No. 1 light lubricating oil ..	8·700	·0642	160 to 180C	·870	180° F.	225° F.	3·659
No. 2 ditto ditto	11·360	·0882	180 to 200C.	·914	250° F.	272° F.	5·027
No. 3 ditto ditto	3·310	·0230	200 to 220C.	·90)	260° F.	283° F.	1·311
No. 1 medium lubribating oil	11·250	·0855	220 to 240C.	·924	272° F.	290° F.	4·873
No. 2 ditto ditto	6·000	·0433	240 to 270C.	·947	310° F.	351° F.	2·468
No. 3 ditto ditto	6·000	·0429	300C.	·966	371° F.	398° F.	2·445
	79·270	·6210					35·394

The analyses which were made in the Black and Esdaile experiments show 64 per cent. lubricating oil, 25 per cent. lighting oil, and 11 per cent. benzine and benzoline. The richness of the shale (1 ton of it yielding as much crude oil in these experiments as 2½ tons of Scotch shale), combined with the low mining costs (1s. 6d. to 2s. per ton of shale, equal to 6s. to 10s. per ton of crude oil) and proximity to port, indicate conditions favourable to a successful enterprise, provided that an extraction method involving moderate working costs can be applied.

2. *Kerosene Shale or Cannel Coal.*—About 16 miles south of Wynyard, an outcrop line of coal seams stretches for about 2 miles north-east and south-west, between the Jessie and Flowerdale rivers, in the Parish of Preolenna. The seams are in a series of sandstones and clays, approximately 250 feet thick, which are known as the lower coal measures of the Permo-Carboniferous system in Tasmania. One of these seams is 20 inches in thickness, and is made up of kerosene shale 6 inches, bright coal 9 inches, splint (?) coal 5 inches. The shale is black; has a pitchy lustre, conchoidal fracture, and is characteristically tough and sextile. Samples assayed in the Tasmanian Government laboratories yielded the following results :—

	Fixed Carbon.	Gases, &c.	Ash.	Moisture.
No. 1	21·0	76·2	2·3	0·5
No. 2	23·2	71·6	4·1	1·1

Samples have also been assayed in the New South Wales Government laboratory, and yielded results as under :—

No. 3	28·51	67·32	2·92	1·25

The Launceston Gas Company tested the illuminating power of the gas yielded by the Preolenna shale, which proved to be about double that of Greta coal. The result extended beyond the limit of the photometer scale used, and was estimated as approximately 40 candle-power per gas referee's burner. The extent over which this seam exists has not been proved by boring or mining work. The shale is only known at two points, but the coalfield has an approximate area of 2 miles by 1 mile. The distance from the nearest port (Wynyard) is too great to allow these seams to be worked profitably until the transport question is settled by the construction of a tramway-line from the coast. Parliamentary sanction has been given for a survey of a line from Burnie to Flowerdale, and, when further facilities exist in this direction a working programme will be brought within the range of profitable discussion. The substance, strictly speaking, appears to be neither shale nor cannel, but is rather intermediate between the shale-cannel group and bituminous coal, and would probably produce benzenes rather than oils.

Barn Bluff.—A somewhat similar coal to the preceding exists in fragments near Barn Bluff, 45 miles from the north coast. The seam from which the pieces have been derived has not been located, but it doubtless exists somewhere in the vicinity. Mr. W. A. Dixon, of the Technical College Labora-

tory, Sydney, considered that it would yield far more tar than oils, which would be difficult to purify. He says, "It is not a cannel from which oils are not made, and not a shale from which they are."

The proximate analyses which have been made of this coal at different times are the following :—

	1	2	3	4	5
Analyst	J. Sharpe, Ballarat.	W. F. Ward, Hobart.	J. C. Newbery, Melbourne.	W. A Dixon, Sydney.	Average analysis.
Water	0·30	0·4	trace	none	0·2
Ash	2·80	4·2	6·05	4·12	4·3
Volatile Hydrocarbons	55·00	51·1	54·20	50·86	52·8
Fixed Carbon ...	41·90	44·3	39·75	43·69	42·4
Sulphur	trace	0·8	not determined	1·33	0·7

In Petterd's Catalogue of the Minerals of Tasmania, the name "Pelionite" is suggested for this variety.

Mr. W. F. Ward, the Government Analyst, obtained 92 gallons of crude oil and tar per ton by very slow distillation; but no investigation has yet been made in the direction of establishing the commercial value of the substance as an oil producer.

W. H. TWELVETREES, Government Geologist.

OUTLINES OF THE GEOLOGY OF TASMANIA.

By W. H. Twelvetrees, Government Geologist.

Tasmania is the separated southern terminal of the Australian Continent. The western half of the island consists of folded Pre-Cambrian and early Palæozoic strata, moulded by denudation into high ranges with crests between 3000 and 5000 feet in height. The central table-land and eastern borders are composed of more or less horizontal beds of late Palæozoic marine strata and Mesozoic sediments, relics of the vanished Gondwana Land. Denudation has exposed huge sills of diabase in these, now crowning the high plateaux and mountains in that part of the island. The plateaux are known by the name of "tiers," and sink by successive faults to sea-level on the east coast. Tertiary fluviatile, lacustrine, or estuarine drifts occupy the floors of the broader valleys, and fill old stream-channels which are now concealed by flows of basaltic lava.

The great movements of igneous material leaving their mark upon the present configuration of the land have been acid and sub-acid irruptions in Cambrian times, the consolidation of gabbro and granite in the Devonian, the intrusion of widespread diabase sills at the close of the Mesozoic, and the effusion of basalt lavas in Mid-Tertiary.

In Pre-Cambrian times Tasmania appears to have been beneath the Algonkian ocean, which received its sediments from continental land to the west. The surface of the deformed Algonkians was subsequently exposed, and furnished material for the Cambrian sediments, which in their turn were eroded and redeposited in the Ordovician and Silurian seas under which most of the present area of the island lay. In the Devonian, land surfaces must have prevailed, as no marine strata of that age are recognisable, and in the Permo-Carboniferous and during the Mesozoic a partial land connection with Australia continued, with shallow waters of a retreating sea. During the Cretaceous, Tasmania was still connected with a part of the adjoining continent, but after the close of that period a separation occurred. Subsequently the land connection was restored, to be again broken, since which time insular conditions have continued. The last land bridge across the straits is supposed to have

been between Wilson's Promontory in Victoria, and Cape Portland in Tasmania, *viâ* Flinders Island, and the Kent Group. It is estimated that an elevation of 300 feet would lay dry a strip of the present sea-bottom between Victoria and Tasmania.

The difficult features and inaccessibility of the uninhabited mountainous parts of the island have greatly impeded geologic research. It has, however, been possible to settle the stratigraphy of a large portion, though the lower Palæozoic strata and the Pre-Cambrian schists still require further study. The following systems or groups of systems are recognised:—

I. Pre-Cambrian.
II. Cambrian.
III. Ordovician.
IV. Silurian.
V. Devonian.
VI. Permo-Carboniferous.
VII. Mesozoic.
VIII. Tertiary.
IX. Quaternary.

I.—Pre-Cambrian.

Strata belonging to this group of systems come to view in the western, north-western, and south-western parts of the island. Whatever horizons may be established for the great breaks in this group, the known Pre-Cambrian rocks developed in Tasmania belong to the upper divisions, called Algonkian by the United States Geological Survey, and comprising dominantly rocks of sedimentary origin (Proterozoic of Chamberlin and Salisbury). The Archæan or lower series, consisting of granitoid rocks and igneous schists, has not been identified in the island. A solitary boulder occurs at the 29-mile peg on Innes' track from Liena to Barn Bluff, having a distinctly Archæan facies, and it may be that the Archæan rocks will be found in the neighbourhood. Up to the present no discovery has been made.

The Algonkian is extensively developed. It forms the platform on which the Cambrian strata have been laid down, and wherever its upper boundary is exposed, rocks of the Cambrian system are in unconformable juxtaposition. Its lower limit has not been seen, but naturally the basal beds must ultimately rest upon rocks belonging to the Archæan complex. No organic remains have been found in them. In some parts the metamorphism is suffi-

ciently intense to obliterate all traces of any life forms, while elsewhere the deformation and alteration have been slight and the rocks have the aspect of merely indurated or crystalline sandstones. In general the Algonkians consist of schistose quartzites, quarzitic, sericitic, and occasionally argillaceous schists.

The possibility of subdivision of the Algonkian is rendered likely by the discovery of what seems to be an upper horizon, indicated by bedded quartzites lying nearly horizontally upon the normal strongly-folded quartzitic schists prevalent in the valleys of the Franklin and its tributaries near the Raglan Range and Frenchman's Cap.

Denison Zone.—The largest continuous development is in the west and south of the island. Lofty schist ranges in parallel north-and-south lines traverse the country west of the King William and Denison Ranges and Mt. Wedge and the area in the south-west between the New River and Port Davey. These schists form the Raglan and Collingwood Ranges, the Frenchman's Cap, the greater part of Mt. Arrowsmith, the lower slopes of Mt. Gell, and the Loddon Range. From below the conglomerates of which the Denison Range is composed, and which strike N. 20° W., quartzitic schists rise with a north-easterly strike, and the same general bearing (with numerous local variations) prevails throughout the whole of the schist country further west. The eastern boundary of the schists is prolonged south of the River Gordon, west of the Wedge River, and then in a direction east of south to the south coast west of New River. The mica schists of the Collingwood River valley are intersected by dykes of garnet-zoisite-amphibolite. Three occurrences of this rock lie between the intersections of the Balaclava and Cardigan rivers with the Collingwood.

South of the Gordon the dominant strike of the schist is between N. 5° and 30° W., and this is also the case in the Port Davey district.

Cox's Bight and Port Davey.—Schistose quartzites and micaceous schists are pierced by tin-bearing granite at Cox's Bight, at the southern end of the Bathurst Range. The bight is 6 miles across, and is divided into two bays by a small promontory called Point Eric, which rises to a peak 160 feet above sea-level. This headland consists of alternate layers of micaceous sandstone and saccharoidal quartzite, contorted and dipping at low angles to the south-west. The strike of these is north-north-west to north-west, and this is the general strike of all the schists and quartzites in

the locality, excepting in the range of dark schists in the eastern bay, where the strike is about north and south. The junction with granite is observable at the neck of the Point Eric promontory, and the igneous rock then forms a spur with rocky knobs rising north from sea-level to 600 feet, where it again junctions with quartzite, which continues to the summit of the Bathurst Range, 2800 feet above sea-level. Cox's Bluff Range is a high headland (about 1000 feet), forming the western horn of the bight, and consisting of dense white quartzite, like many of the bluffs which jut out on this part of the coast, with bare snow-white crests visible for many miles. The white quartzite of Port Davey has long been assumed to be of Pre-Cambrian age. This series of schists and quartzites continues westwards to South-West Cape, and eastwards to the high land west of the New River.

Barn Bluff and Dove River.—The country round Barn Bluff consists principally of foliated quartz schists with a general east-and-west strike, or slightly north of west and south of east. Micaceous and argillaceous schists are also present. This Pre-Cambrian country continues as far north as the Dove River.

Ulverstone and Forth.—At the mouth of the River Leven, quartzitic and sericitic schists and schistose conglomerates, with beautifully stretched quartz pebbles, are well exposed along the beach eastwards as far as Button's Rivulet, where they are covered by basalt of Tertiary age, with a general strike of N. 10° E.; and westwards past Picnic Point to halfway across Barkworth's Bay, west of Goat Island, where their junction with the overlying Dundas and Leven Cambrians is hidden by a flow of lava. The striped slates and breccia a little further west appear with a strike of from N. 15° to 25° W., showing their strongly unconformable position on the Algonkian schists. The schistose conglomerates at Goat Island furnish classical examples of dynamically deformed pebble beds, the quartz pebbles being stretched into lenticles and long narrow strips without fracture. The strike of the schists west of Goat Island ranges from N. 12° to 30° E., with a north-westerly dip.

At Hamilton-on-Forth a picturesque river gorge exposes the ancient rocks beneath a thin covering of Tertiary basalt, which occasionally assumes a felsparless or limburgitic facies. To the north-west of the township crags of saccharoidal white quartzite overlook the river. This

is bounded on the west by the basalt. Further south along the road there emerges from below the basaltic sheet a small exposure of serpentine about a chain wide. The next body of rock westerly is micaceous quartz schist striking N. 10° W., and dipping south-west. South-east of this, and on the same strike, is a belt of garnet-zoisite-amphibolite with a north-westerly bearing. This is succeeded on the west by mica schist and micaceous quartzite with strike of from N. 10° to 30° W., and a south-westerly dip. The schist is sometimes graphitic. Further south intrusions of porphyroid occur, and the Algonkian platform sinks below the Cambrian slate and breccia series.

Rocky Cape.—A series of quartzites and quartz schists is exposed along the north-west coast of Tasmania from Jacob's Boat Harbour west of Wynyard to Rocky Cape, which forms a promontory on the east side of the bay extending to Circular Head.

The Rocky Hills form a high range of massively bedded quartzite, which trends south or a little east of south from the coast to about a mile south of the main road, when it sinks rather abruptly, and subsides in the country which extends south across the Arthur River towards the Heazlewood and Long Plains. Immediately west of the Cape are contorted quartz schists, which are a part of the complex of schists and quartzites which succeed one another on this part of the coast. The strike of the quartzite at Rocky Cape port is north of east, and of the curled schist west of same N. 80° E. The quartzite here is coarsely bedded and not schistose.

The same series extends eastwards to Jacob's Boat Harbour, where the strike is north-west, with a north-easterly dip.

Rocky River Schists.—This formation is met with on the Waratah-Corinna-road, at 26 miles from Waratah, and continued to 31½ miles with a strike of about N. 10° W. and a north-easterly dip. The observed width of the belt is about 1½ mile. On the east it is bounded by the Long Plains series of quartzitic, sericitic, and graphitic schists. The country to the west has not been closely examined, but slate and quartz schist occur in it. The Rocky River schists continue north-west for 10 miles to the Savage River, and perhaps 3 or 4 miles further north. For this distance they maintain their lithological characteristics, and at intervals expose their characteristic ore outcrops. These comprise large lenses of magnetite and hematite, with a variety of associated minerals—gold, silver, copper,

pyrrhotite, pyrite, barytes, arsenide and antimonial sulpharsenide of nickel, cobalt molybdate, asbestos, siderite, dolomite, calcite, arsenopyrite, &c. On each side of the ore-bodies, and separated from them only by bands of more siliceous schist, are the amphibolitic schists of this zone, which are sometimes gneissoid and fissile, sometimes typically foliated, or compact, or granular with irregular fracture. Smooth talc-like schists are frequent. The elements forming the amphibolite are a rather fresh-looking acid plagioclase in large plates, a green amphibole, sometimes decidedly bluish-green in thin section, with the extinction angles of common hornblende; apatite in large formless crystals; quartz; and much epidote. The rock obviously belongs to the amphibolitic crystalline schists, and possibly was once gabbro, the pyroxene of which has been replaced by hornblende and the basic felspar transformed into more acid felspar and quartz. The presence of nickel ore and the frequent development of serpentine in the joint planes of the rock harmonise with this supposition.

At the junction of the Whyte River with the Nine-Mile Creek, where some copper ore mining has been carried on, this zone contains actinolite schists.

Long Plain Schists.—The rocks on the Long Plains between Waratah and Corinna may be placed in the Pre-Cambrian. They comprise sericitic, graphitic, and quartz schists striking a little east of north. A good deal of loose gold has been obtained from the creeks north of the plain (in nuggets up to 5 ozs. in weight), as well as from the angular hill detritus. Gold in ragged, spongy, and crystalline forms has been obtained from softened zones in the schist.

Asbestos Range.—This is a majestic linear range 5 or 6 miles west of Beaconsfield, terminating northwards in promontories at Badger Head in Bass Straits. No asbestos has been found in it. The range has been so named from its lying immediately to the west of the Anderson's Creek belt of serpentine, in which veins of chrysotile or serpentinous asbestos exist. The serpentine intrusion obscures the junction of the schists of this range with the Cambrian grits and sandstones of the Beaconsfield district. The rocks of which the range is composed are micaceous schists, slates, and grits, striking N. 10° to 20° W.

Ore-deposits in Pre-Cambrian Rocks.—Ores of copper, antimony, and lead occur in the schists at Port Davey, copper and nickel ores (with gold and silver) in the Rocky

River belt, gold in the Long Plain schists, and disseminations of copper ore in dykes traversing the quartzite at Rocky Cape and Jacob's Boat Harbour. Gold has been found in sericitic quartzite at the Gell River, 19 miles north of the Great Bend of the Gordon, and has been reported from several points in the schist area. Copper ore occurs in the Asbestos Range schists, and in quartzite and actinolite rock at Barn Bluff.

II.—Cambrian.

The base of the system, where observed, rests unconformably upon the upper Pre-Cambrian rocks, which were subjected to foliation and erosion before the overlying Cambrian strata were deposited. Recent information has shown that the clay slates and breccias which in early literature were called Cambro-Silurian, and more lately Cambro-Ordovician, may be regarded as belonging to the Cambrians. The West Coast conglomerates, the schistose porphyries of the West Coast Range, and the felspathic schists of Mt. Lyell, about which uncertainty has been felt for a long time, may be almost certainly placed in the same system.

The grouping of the beds in the Cambrian is somewhat provisional at present, as investigation is still proceeding, but the following groups have been recognised:—

(4) Dikelocephalus sandstone at Caroline Creek and the Florentine.

(3) Discoidal sandstone in the Loddon River valley and at Caroline Creek near Dulverton.

(2) Tubicolar sandstone at Middlesex, Five-mile Rise, Mt. Claude, Lemonthyme Hill, Black Bluff, Zeehan, Loddon River Valley.

(1) Conglomerates, pebbly sandstone, and quartzite on the West Coast Range, Mt. Zeehan, the Thumbs, Denison Range, Railton, &c.

Incertae Sedis.

(*a*) The Dundas slates and breccias, the Dial Range, and Leven slates, breccias, tuffs, and porphyroids; the felspathic porphyries of Mts. Lyell, Jukes, and the West Coast Range generally.

(*b*) Slate and sandstone at the Needles and in the neighbourhood of Mts. Mueller and Wedge.

(1) *Conglomerates.*

The great Denison Range flanks the valley of Rasselas to the west as one proceeds north of the Gordon Bend. First comes its southern offshoot (Mt. Wright), which forms a high wall on the west for about 5 miles, and then the main ridge of the Denison in continuation of the Thumbs and the mountain north of Clear Hill comes to the front and rises above the plain in lofty peaks. The western face of this range is composed of crystalline and pebbly sandstone, weathering into a visible conglomerate, the small pebbles of quartz showing on the weathered surfaces. These beds are succeeded to the west by strong bands of medium-grained and coarse conglomerate, which, with beds of sandstone, continue to the summit of the range. Behind these are quartzites, dipping conformably below them. Still further west are similar alternations. The whole forms the basal formation of the Cambrian system, striking N. 30° W., and dipping 45° to 50° north-easterly. The beds plunge below the Ordovician limestone on the east, and transgress the Algonkian strata on the west. The latter strike east of north. At the junction of the systems is a basal breccia bed composed of large angular stones of quartz and quartz schist. This is the lowest bed which has as yet been noticed in the Cambrian system.

No essential distinction can be made between these conglomerates and those of the West Coast Range. The series extends as far south as the head of the Florentine River. The general colour of the conglomerate is white or pink (reddish where fine-grained), and the pebbles are of quartz and quartzitic schist. Such conglomerate appears on nearly all the mountains of the West Coast Range, and on many in the north of the island, such as Valentine's Peak, Mt. Roland, &c. It exists near Railton behind the Cambrian beds. It underlies tubicolar sandstone at Mt Zeehan, and is associated with similar sandstone at Black Bluff. It forms the footwall of the felspathic schists at the Mt. Lyell Mine. It underlies Ordovician limestone at the Upper Blythe. The steadily growing evidence seems to require its inclusion in the Cambrian system, though it has hitherto been considered as being of much younger age.

The beds of quartz grit, conglomerate, and sandstone, which form the Cabbage Tree Hill at Beaconsfield, pass below the Ordovician limestone in the eastern part of the township at an angle of 45° to 50° to the north-east.

The strike of the beds is north-westerly. A fault exists at the junction of the two systems here.

Some casts of orthis have been found in the whitish sandstone of the Cabbage Tree Hill; and on the surfaces of light grey slate from the Tasmania and Salisbury Mines undetermined markings and tubular forms have been found and referred to planolites and fucoids.* The term planolites covers various obscure cylindrical impressions supposed to be casts of the tracks of worms travelling over the surface of sand or mud.

(2) *Tubicolar Sandstone.*

This is a white crystalline sandstone seen in the Middlesex and Mt. Claude districts, at Zeehan, and in the Loddon River valley. It is known locally as "pipe-stem rock," from its abundant fossil forms, taken to resemble the stem of an ordinary clay pipe. These are sometimes straight, sometimes slightly curved. Sometimes they lie parallel with the bedding, sometimes vertical. Their forms project from or lie in relief on the weathered surfaces of the rock or stones, but their substance is wholly made up of quartz grains, and no signs of structure can be detected even by microscopic examination. Any name given to them must be entirely conjectural. They may be worm tracks, or possibly the fillings of dwelling tubes constructed by some tubicolar annelid. For the present, the rock carries the non-committal name of tubicolar sandstone. It plainly forms such an excellent stratigraphical horizon that its relations with its associated beds are important for Tasmanian geology.

Silurian fossils have been collected from the Bell Mount and Five-mile Rise districts, but the stratigraphy of these areas has not been worked out closely, and for a long time the tubicolar rock has been believed to be of Silurian age: but recent investigations lead to the conclusion that it must be Cambrian. It directly overlies the basal Cambrian conglomerate at Mt. Zeehan. These tubicolar forms have been found in the Cambrian conglomerate of Mt. Lyell Peaks. The rock is associated with Cambrian conglomerate at Black Bluff; it underlies Ordovician limestone on the eastern side of the Forth River near Lorinna.

(3) *Discoidal Sandstone.*

In the valley of the South Loddon the tubicolar rock is overlaid conformably by a whitish sandstone, which is

* By Mr. R. Etheridge, Jr.

charged with impressions of a peculiar discoid form, in appearance somewhat resembling encrinital stem segments. Similar forms, though much smaller, occur in a thin bed in the Upper Cambrian sandstone on the railway-line at Caroline Creek. It may be added that in the valley of the South Loddon River, the tubicolar sandstone overlies unconformably the Algonkian schists.

(4) *Dikelocephalus Sandstone.*

Yellow friable sandstones, grits, and claystones, with the Dikelocephalus fauna, underlie Ordovician limestone at the Railton lime quarry; and the same series of beds crosses the railway-line at the Caroline Creek, 2 miles north-west of Dulverton Siding. The following organic remains have been obtained from these beds:—Dikelocephalus tasmanicus (Eth.), Asaphus sp., Ophileta sp., Ptychoparia stephensi (Eth.).* A univalve, referred by Mr. Etheridge to Raphistoma, has been found in the Cambrian beds behind the quarry. All these beds strike north-west and dip south-west. In the south of the island on the west flank of Mt. Stephens (Tim Shea locally) in the Florentine Valley, belts of yellow claystone and soft sandstone have yielded another form belonging to the same genus of trilobites, viz., Dikelocephalus florentinensis.

(*a*) *Dundas and Leven Slates and Breccias, &c.*

Green and purple slates, breccias, and brecciated conglomerates prevail in the North Dundas district, intruded by porphyroids or dynamically altered quartz and felspar porphyries, and interbedded with the tuffs of these (clastoporphyroids). Some of the latter have the appearance of indurated sediments, and lithologically resemble European greywackés, but their origin is probably attributable to volcanic action, and in all likelihood they were submarine tuffs. Slate on the North-East Dundas railway has yielded indistinct graptolite markings, interpreted as belonging to the Dendroidea, and probably to the genus Callograptus. At 12½ miles from Zeehan, on this railway-line, some slate was collected, showing monoprionidian graptolite thecæ.†

The central and western portions of the Zeehan field comprise a series of slates, tuffs, and breccias, which are lithologically identical with those of the Dundas and Leven series. They form a clearly marked horizon in a great-

* Formerly Conocephalites stephensi. † Determined by Mr. T. S. Hall, M.A.

sedimentary series, which consists for the most part of dark grey slate and white sandstones and grits.

Interbedded with these latter are beds of tuffs and isolated areas of vesicular lava sheets and dykes. Petrologically these effusive rocks at some points resemble the spilite or amygdaloidal diabase of German authors; at others, they display clearly marked porphyroidal affinities. The majority of the Zeehan lodes are enclosed within these rocks.

Lithologically similar breccias, tuffs, and slates occur in the Leven Gorge, at Gunn's Plains, where they underlie the Ordovician limestone with an unconformable angle of dip. Intrusive porphyroids are associated with them here also. On the North-West Coast, in Barkworth's Bay, west of Goat Island, this breccia series rests unconformably upon the Algonkian schists and schistose conglomerates. The series is exposed all along the beach from Lodder's Point to the Penguin township, and on the Dial Range.

This series may be distinguished from the conglomerate on the West Coast ranges by the abundant breccias, the cherty nature of the fragments, and general absence of quartz pebbles.

The varied massive and schistose porphyries intimately associated with them correspond with similar developments of igneous rock at Mt. Lyell, Mt. Farrell, and on the West Coast Range generally, for which a like age must be accepted as probable. These are the dynamically affected quartz and felspar porphyries, to which the convenient descriptive term "porphyroid" has been applied. They are associated with granites and syenites, which are generally more basic than the Devonian granite, and they constitute a complex group of acid and sub-acid porphyries and porphyrites, with some, as yet, imperfectly understood basic varieties.

The Leven porphyries extend as far south as Bell Mount, where they may be seen in the road cutting round that hill; and in the axial line of the West Coast Range they stretch from Bass Strait to Birch's Inlet, on Macquarie Harbour. Fragments of this kind of porphyry enter into the composition of the Permo-Carboniferous conglomerates in regions drained by the Gordon and Derwent Rivers and their tributaries, and when released from the matrix have frequently misled the searcher for granite exposures.

No intrusion of porphyroids has been observed in Ordovician strata, and from the evidence accumulated in various portions of the island the period of eruption must have

terminated before the close of the Cambrian. It is still difficult to precisely define the exact horizon occupied by the slates and porphyroids, but stratigraphical evidence appears to indicate that these rocks belong to the Upper Cambrian.

(*b*) *Slate and Sandstone at the Needles, &c.*

At the eastern base of the Needles, between Mt. Stephens (Tim Shea) and Mt. Mueller, a belt of reddish and purple slate and quartzite strikes north-west with a north-easterly dip. It underlies Ordovician limestone on Wherret's Look-out, and forms the country rock at the Humboldt Copper Mine.

Clay slates and quartzites of Cambrian age are also seen west of Mt. Mueller and all round the base of Mt. Wedge, but it is uncertain what horizon they occupy in the system.

III.—Ordovician.

The actual sequence of Ordovician strata in Tasmania has not yet been ascertained. The Gordon River limestone, however, has been observed succeeding Upper Cambrian beds at Railton, and it is taken as being the base of the system. Accordingly, the Ordovicians are divided as follows:--

(2) Slate and sandstone in the goldfields of Lefroy, Mt. Victoria, Mathinna, Mangana, &c.

(1) Limestone on the Gordon, Florentine, and other rivers, at Railton, Mole Creek, Beaconsfield, &c.

(1) *Gordon River Limestone.*

This is exposed at various places throughout a great portion of the island from north to south and from west to centre. It appears at Point Hibbs, in the Lower Gordon, in the Franklin, Denison, and Jane Rivers, in the Valley of Rasselas, in the Florentine Valley, on Mt. Humboldt, Mt. Müeller, at the Junee Caves, on New River, at Mt. Farrell, Upper Blythe, Gunn's Plains, the Don River, Railton, Chudleigh, Mole Creek, Winkleigh, Beaconsfield, &c.

The limestone at Railton strikes N.W.-S.E., with a dip to the south-west. It rests with a slight unconformability on the Dikelocephalus-bearing sandstones of the Caroline

Creek series. It has yielded numerous specimens of Actinoceras.

The organic remains determined from the occurrences along the Gordon River include Favosites, Halysites, Syringopora, Stenopora, Orthoceras, Phragmoceras, Lituites, Orthis, Rhynchonella, Raphistoma, Euomphalus, Murchisonia, and the following species established by Mr. Johnston:—Straparollus tasmanicus, Scalites salteri, Scalites gouldii, Trochonema etheridgei, Tellinomya jonesii, Modiolopsis gordonensis.

The Gordon River from the entrance to the Gorge eastwards at the Great Bend shows numerous bars of this limestone crossing its bed, forming a limestone belt about 1½ mile wide. The rock here is dark grey, regularly bedded and somewhat argillaceous. On the hills near the Gorge it contains some impressions of Orthis. Its strike is N. 25° W., and its dip north-easterly, at about 70°. It is evidently the bedrock of the Gordon Plains and the Rasselas Valley. It is underlaid on the west by the crystalline pebbly sandstone, conglomerate, and quartzite, which form the front wall of the Thumbs and Mt. Wright, and which there is reason to believe are Lower Cambrian.

Similar limestone is met with a few hundred feet west of the Florentine River, and again east of the river, striking N. 10° E., and dipping north-westerly. It is also exposed east of the Little Florentine River, with about the same strike and dip. It reappears on the shoulder of Mt. Field West, and again at the Junee River, striking north-west and dipping north-easterly. Impressions of fossil shells resembling Orthis lenticularis are met with in this limestone at the Junee River and in the Valley of Rasselas.

Further south the limestone occurs at the head of the Styx River, and between that place and the Upper Florentine Valley. At the junction of the Gordon and Port Davey tracks it is faulted against the Cambrian conglomerate of Junction Hill. In the extreme south of the island it exists on the New River.

At Copper Creek, on Gunn's Plains, the same rock lies unconformably on the Dial Range breccias and conglomerates, and the same relations obtain at the Upper Blythe. At Beaconsfield it is faulted against the Cambrian grits and conglomerates of the Cabbage Tree Hill.

Its occurrence at Mt. Farrell is in the bed of the Macintosh River, a short distance above the junction of the latter with the Sophia River, where it is fossiliferous.

(2) *Auriferous Slate and Sandstone Series.*

This series is assumed to be of Ordovician age, partly from its analogies with Victorian strata, partly from the absence of Silurian fossils. It is, however, strange that no grapholites have been discovered. The strata form a well-recognised belt of clay slate, arenaceous slate, sandstone, and quartzite, extending from Fingal and Mangana through Mathinna to Mt. Victoria and Warrentina. To the north-west the zone widens so as to embrace Lisle and Lefroy. The general strike of the strata throughout the belt is N. 20° to 30° W., with varying dips due to anticlinal folds. From St. Patrick's River to Back Creek the dip is north-easterly, but changes to the south-west a few miles from Lefroy. As a north-easterly dip prevails on the west side of the Tamar, the river is either in a synclinal valley or masks a fault.

The gold quartz reefs which run through the belt apparently began to form after the close of the Silurian, and are a constant feature of the entire belt.

IV.—Silurian.

This system is represented by the following subdivisions:—

(2) Eldon Valley clay slates.
(1) Fossiliferous limestone, sandstone, and slate at Zeehan, Heazlewood, Queen, and Nelson Rivers, Lorinna, &c.

(1) The Silurian strata at Zeehan, believed, on the evidence of their contained fossils, to be of Middle Silurian age, comprise slates, limestone, and sandstones. These beds occupy a position to the eastward of the Cambrian sandstones, slates, and breccias, save where by faulting, the isolation of small Silurian areas within Cambrian boundaries has occurred.

Lithologically there is a very close resemblance between the Silurian and the Cambrian sediments on the Zeehan field, a fact which has been responsible for the massing of the two groups in previous geological literature. There are, however, marked differences between the assemblages of organic remains preserved in the rocks of the two systems.

The general strike of the Silurian sediments in the Zeehan field is between 45° and 80° west of north. Post-Silurian faulting has disturbed the beds, and minor varia-

tions of strike are frequent. The limestones appear to be the basal members of the system.

Mr. Etheridge has determined the following organic remains:—

From the Despatch Limestone—
- Asaphus, sp. ind.
- Hausmannia meridianus (Eth. fil and Mit.).
- Hausmannia, sp. ind.
- Illaenus johnstoni (Eth. fil).
- Amphion? brevispinus (Eth. fil).
- Leptodomus? nuciformis (Eth. fil).
- Eunema montgomerii (Eth. fil).
- Orthoceras, sp. ind.

From blue-grey Slate at Zeehan—
- Cornulites tasmanicus (Eth. fil).
- Cromus murchisoni (De Kon.?).
- Rhynchonella borealis (Schlotheim?).
- Rhynchonella cuneata (Dalman).
- Strophodonta, sp. ind.
- Tentaculites, sp. ind.

From white Quartzite at Zeehan—
- Lophospira, sp. ind.
- Murchisonia, sp. ind.
- Raphistoma, sp. ind.

The Silurian beds are penetrated by dykes of granite-porphyry, which have suffered faulting and crushing by later earth movements.

To the west of the Zeehan field is a large development of gabbro and serpentine, forming the aureole of the granite mass of Mt. Heemskirk.

Numerous silver-lead veins intersect the field in all directions, and at least one valuable lode of stannite exists.

At the Heazlewood, in the vicinity of the Whyte River, are limestone and sandstone strata of the same age as the Zeehan series, striking N. 40° W., and dipping generally to the north-east.

Mr. Etheridge has determined the following forms from these beds:—

- Cornulites tasmanicus (Eth. fil).
- Cromus murchisoni (De Kon.).
- Rhynchonella decimplicata (J. de C. Sow.).

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* NOTE.—For much of the palæontology of this paper the works of R. M. Johnston, A. C. Seward, E. A. Newell Arber, R Etheridge, Jn., J. Shirley, Dennant and Kitson, V. Ellingshausen, Feistmantel and others have been consulted and used. Mr R. Etheridge and Mr. F. Chapman have freely given assistance in several determinations.

Rhynchonella capax (Conrad).
Tentaculites, sp. ind.

Silurian sandstone with abundant casts of Rhynchonella occurs near Lorinna, on the Five-mile Rise.

Grey, white, and yellowish gritty sandstones, plentifully charged with impressions of brachiopods, are found in the valleys of the Queen and Nelson Rivers, and west of Queenstown on an old track leading to Howard's Plains. Some brachiopod-bearing sandstone occurs at the Mt. Lyell Mine in close proximity westwards to the large clay course, which runs in a northerly direction through the Reward claims. Rock met with underground in the Lyell Blocks Mine has yielded specimens of a Rhynchonella, which, *vide* Mr. Etheridge, is, in all probability, R. Capax (Conrad). Similar specimens occur behind the township of Gormanston. Fragments of similar rock have been found on the Gordon track, 5 miles from Tyenna.

Trilobite-bearing Silurian rocks exist also near the Wilson River, north of the Pieman. On the north-west face of Mt. Arrowsmith Silurian sandstone dips west at a low angle.

In the Eldon Valley are clay slates and mudstones, with undetermined forms of Calymene, Orthis, Cardiola, &c., which have been placed provisionally at the base of the Silurian.

At the White Hawk, north of Mt. Farrell, a bed of limestone occurs between a sandstone on the west and pebbly sandstone on the east, the whole dipping westward. The sandstone below the limestone contains impressions of Rhynchonella borealis, and that above has many impressions of Rhynchonella capax. (Conrad), var. meridionalis (Etheridge).

V.—Devonian.

The gap between the Silurian and Permo-Carboniferous is not bridged by any record of sedimentation. Doubtful beds occur near Fingal and in the Eldon Valley, but they are too insufficiently known to admit of classification.

This period, however, was marked by the intratelluric consolidation of a great mass of igneous rock, subsequently exposed and appearing in various parts of the island in the form of granite and serpentine. The serpentine is generally a peripheral mantle of serpentinised gabbroid and ultra-basic rocks surrounding the granite masses on the West Coast. Occasionally between the granite and serpentine is an aureole of actinolitic rock. On the East

Coast, however, serpentine has not been met with. The localities where serpentine is known to occur are as follows:—Trial Harbour, Comstock, Dundas, Parson's Hood, Heazlewood, Hamilton-on-Forth, Styx River, Upper Florentine River, Boyes River. Aplitic and other granitoid veins have been noticed to invade serpentine at the Heazlewood and Anderson's Creek; gabbro, in the North Dundas tinfield, is also traversed by granite-porphyry dykes. There is a junction of granite with serpentine on the beach at Trial Harbour. At the contact the serpentine is highly altered, and is penetrated by small dykes of porphyry, which proceed from the granite mass. These facts indicate the prior consolidation of the basic rock.

Granite occurs in a meridional line down the East Coast, extending from Flinders Island to Maria Island. It forms Mt. Cameron, Mt. Stronach, the Blue Tier, Freycinet's Peninsula, and is exposed at Ben Lomond, Lyell, Golconda, and at the base of Mts. Arthur and Barrow. Exposures are also seen at Middlesex, Granite Tor, Upper Blythe, Hampshire Hills, Heazlewood, &c. The Meredith Range and Mt. Heemskirk are huge granite massifs. The most southerly occurrence is at Cox's Bight.

Granite or acidic vein-matter penetrates all rocks of earlier date than Permo-Carboniferous; but granite itself has not been seen intrusive in strata of the latter age.

An important feature by which the Devonian granite is lithologically distinguishable from the older granitic and syenitic rocks of the porphyroid group is its uncrushed character. It has not been subjected to the dynamic stresses which the Cambrian granites and syenites have undergone.

The normal rock is a biotite granite. In the tin-mining districts a development of muscovite or lithia-bearing mica takes place, and greisen formations frequently occur, accompanied by patches and veins of pegmatite. Where granite exists on the goldfields of the North-East (round Mts. Barrow and Arthur) hornblende enters into its composition. Tin-bearing lodes occur in the granite at Ben Lomond and Mt. Heemskirk, while on the Blue Tier floors or stocks of altered granite form large tin-ore bodies of low grade. Quartz or granite-porphyry dykes at Mt. Bischoff have shed the vast accumulation of tin ore which has been mined there for the last 36 years with wonderful success.

The quartz-porphyry and granite-porphyry dykes in the Dundas district, the tourmaline-gold-copper lodes at Mt.

Black, the axinite veins at the Colebrook, and the stannite lodes, and quartz-porphyry dykes at Zeehan, all denote a granitic reservoir below the mineral fields of the West Coast; and the gold quartz reefs of the eastern part of the island may be similarly interpreted. Serpentinised rocks at the Heazlewood, Dundas, and Trial Harbour carry lodes of silver-lead, copper, and nickel ores. Osmiridium (iridosmine) is a constituent of sands in the neighbourhood of serpentine masses (always associated with gold). An extraordinary feature is the occurrence of tin ore with serpentine at Dundas.

VI.—Permo-Carboniferous.

This system in Tasmania represents a time interval which is too late in the geological record to be called exclusively Carboniferous, and as a whole too early to be exclusively Permian. It shows no traces of the Carboniferous Lepidodendroid flora and Calamites. Cooler, or even frigid, climatic conditions were ushering in the Glossopteris flora, which had already appeared in the Australian Carboniferous. Such characteristic forms as Productus semireticulatus, Spirifera striata, and the Phillipsia trilobite, which lived in Australian Carboniferous waters, are unknown in Tasmania, though many other Carboniferous species still lingered. On the other hand, Stenopora, Strophalosia, &c., give a Permian facies to the marina fauna. Generally an impoverishment of marine forms of life was in progress.

During this time a continued process of withdrawal of the sea took place, finally leaving the surfaces of the older, folded strata, covered with comparatively shallow sheets of water, forming probably chains of lakes and arms of the sea. Oscillations of the strand level were inconsiderable. The sedimentation would seem to have been largely in enclosed or partially enclosed seas, or at most, on an epicontinental sea-floor. The base of the system rests upon the ancient rocks (Cambrian, Ordovician, or Silurian); sometimes upon the Devonian granite, which was then in places already exposed by denudation.

Glacial conditions prevailed at the time of the deposition of the basal conglomerates. Similar conditions are known to have existed in Australia, India, and Southern Africa during this period. The similarity of the Permo-Carboniferous and Mesozoic flora in these three continents (including Tasmania) is suggestive of a mutual land connection—that of the hypothetical Gondwana Land.

The Permo-Carboniferous strata in Tasmania are usually horizontal or gently inclined. They have not been deformed by folding, but have been greatly depressed or raised by faulting. The sills of diabase, which have penetrated them on an enormous scale, do not seem to have tilted them to high angles. Innumerable displacements, however, have been caused by faults.

The thickness of the maximum development of the beds belonging to this system is estimated at about 2000 feet.

The strata comprise conglomerates, grits, limestones, sandstones, and mudstones, with shales and thin coal seams, all indicative of shallow-water conditions. They appear at the surface over a large area, being exposed in nearly all parts of the island.

The subdivisions are as follow:—

Upper—

(6) Elæolite and alkali syenites with various alkaline porphyries at Port Cygnet and along D'Entrecasteaux Channel. Precise age unsettled.

(5) Southport sandstones and shales.

(4) Mt. Cygnet and Adventure Bay sandstones and shales.

(3) Upper Marine mudstones overlying Mersey coal; Porter Hill shales and sandstones, Sandy Bay.

(2) Lower coal measures (= Greta horizon, N.S.W.), Mersey Basin, Preolenna, Henty River; Tasmanite beds.

Lower—

(1) Conglomerates, grits, limestones, and lower marine mudstones throughout South-East, North-East North-West, and Midlands. Glacial conglomerates, grits, micaceous sandstones, and slaty flagstones in thick beds form the base of the system.

(1) The base sometimes consists of marine gritty conglomerates, as on Bruni Island, with erratic boulders; sometimes of limestone and conglomerate with a calcareous cement, also carrying erratics; or of glacial till, conglomerates, and sandstones with erratics, as at Wynyard, or of marine mudstone with boulders, as on the banks of the Derwent. The glacial beds at Wynyard, where a full development of them occurs, have been estimated by Prof.

David to represent a thickness of 1200 feet. The basal beds are well represented on Bruni and Maria Islands.

On Maria Island, north-east of Darlington, are coastal cliff sections, below Mt. Maria (with its twin peaks, the Bishop and Clerk), showing nearly 600 feet of limestone and mudstone, the lower 10 or 12 feet of which consist of boulder limestone and conglomerate, with large erratic blocks of granite, slate, and sandstone. The series as here developed has been divided by Mr. R. M. Johnston into palæontological zones as follows (in descending order):—

(v) Crinoid zone.
(iv) Productus zone.
(iii) Fenestella zone.
(ii) Pachydomus zone.
(i) Erratic zone.

(i) Some of the erratics in this zone weigh over a ton. The matrix between the boulders is impure limestone.

(ii) This zone, in which Pachydomus predominates, is 80 feet in thickness, and comprises beds of limestone and calcareous shale. One bed, 40 feet thick, is almost entirely composed of shells of Pachydomus. The following are characteristic fossils of this zone:—Pachydomus globosus (J. de C. Sowerby), P. de koninckı (Johnston), P. hobartensis (Johnston), P. gigas (McCoy), P. carinatus (Morris), Eurydesma cordata (Morris), Notomya gouldii (Johnston), N. trigonalis (Johnston), N. beddomeii (Johnston), Deltopecten limæformis (Morris sp.)*, D. fittoni (Morris sp.), Aviculopecten squamuliferus (Morris), Platyschisma ocula (J. de Sow), Conularia tasmanica (Johnston), Stenopora tasmaniensis (Lonsdale), S. informis (Lonsdale), S. ovata (Lons.).

(iii) This zone consists of mudstones 124 feet thick, replete with crushed specimens of Fenestella internata (Lons.), F. plebeia (McCoy), Protoretepora ampla (Sow.). With these are Spirifera tasmaniensis (Morris), S. darwinii (Morris), S. glabra (Morris), S. duodecimcostata (McCoy), Productus brachythærus (G. Sow.), Strophalosia clarkei (Eth. fil), Pleurotomaria morrisi (McCoy).

(iv) This zone includes a group of blue hydraulic limestones worked at one time for Portland cement. Beds of

* = Aviculopecten limæformis (Johnston). Deltopecten is a genus formed by Etheridge fil in 1892, occupying an intermediate position between Aviculopecten and Pecten proper. *Vide* Monograph of the Carboniferous and Permo-Carboniferous Invertebrata of New South Wales, by R. Etheridge, Jr., and W. S. Dun, 1906, p. 22.

calcareous shale and mudstone separate the limestone bands. The limestones contain Stenopora, Fenestella, Crinoids, Spirifera, Strophalosia, Productus, Deltopecten, Pachydomus.

(v) The Crinoid zone embraces limestones which are composed principally of Crinoid remains, and is about 30 feet in thickness.

The dip of the entire group of beds is to the south-east.

The lower division of the Permo-Carboniferous is also developed on Bruni Island, in D'Entrecasteaux Channel. The eastern shore of this island abounds in cliff escarpments, the stratified rocks dipping south of west. The core of the island is diabase. A narrow strip of sandy beach, 6 or 7 miles long, connects North with South Bruni. The marine Permo-Carboniferous beds flank the diabasic backbone of the island up to a height of 300 or 400 feet. The basal beds here are marine gritty conglomerates, with Spirifera strzelecki, S. darwinii, Pterinea macropteris, and trunks of conifers. At One-tree Point, North Bruni, the lower beds are grits, conglomerates, limestone, and white and yellow arenaceous mudstones. Stones of granite, porphyry, slate, &c., are common in the conglomerate. Some of the boulders are of huge size, and their transport is ascribed to the agency of ice. Overlying the conglomerate is a bed of limestone 4 feet thick, composed nearly entirely of large specimens of Stenopora ovata (Lons.). Large conifer trunks are embedded in both the limestone and conglomerate.

At Variety Bay, a little north of Cape Frederick Henry, the fossiliferous mudstones are well exposed. Mr. R. M. Johnston gives the following descending section.

	Feet.
6. Fenestella Zone.—Finely laminated mudstone, with abundant Fenestella fossula and Protoretepora ampla	70
5. Spirifer Zone.—Siliceous limestone, with casts of Spirifera convoluta, S. strzelecki, Dielasma (Terebratula) sacculus, Deltopecten limæformis, Deltopecten fittoni, &c.	12
4. Pleurotomaria Zone.—Hard, dense, siliceous rock replete with thin layers almost wholly composed of the casts of Pleurotomaria morrisiana	4
3. Siliceous limestone and mudstone, with occasional casts of Pleurotomaria morrisiana	10
2. Hard conglomerates and grits without fossils	4
1. Diabase.	

These beds have a westerly dip of from 15° to 20°

For 5 miles along the sea coast east and west of Wynyard the basal glacial beds of the Permo-Carboniferous system are exposed at water-level, dipping north-westerly at low angles. They consist of glacial till, conglomerates, with ice-scratched boulders, sandstone, and clay shale, and rest upon dark Ordovician slate containing Phyllograptus, Diplograptus, various Phyllocarids and brachipods allied to Obolella.

The Lower Marine mudstones are exposed all along the Derwent Valley, near Hobart, at Glenorchy, Bridgewater, New Norfolk, on the Styx River, near Tyenna, &c. They rise by a succession of faults to a height of 2000 feet on the slopes of Mt. Wellington. The Huon-road, as it rises from the city of Hobart, shows good sections of these beds.

The main subdivisions are—

3. Fenestella mudstones, at Cascade, Grange, Porter Hill, &c.
2. Spirifera and Strophalosia mudstones, Huon-road.
1. Pachydomus limestones and sandstones, Cascades, Bridgewater.

The principal organisms found in the above are as follows:—

Pachydomus Zone.	*Spirifera Zone.*	*Fenestella Zone.*
Pachydomus koninckii	Spirifera darwinii	Fenestella internata
" globosus	" duodecimcostata	" plebeia
" hobartensis	" convoluta	Prototetepora ampla
Eurydesma cordata	" strzeleckii	with organisms of the other two zones
Spirifera convoluta	" glabra	
" stokesii	" tasmaniensis	
Productus brachythærus	" ovifórmis	
Aviculopecten (Deltopecten) limæformis	" lata	
" fittoni	" vespertilio	
Pleurotomaria morrisiana	" stokesii	
Pterinea macroptera	Orthotetes crenistria	
Conularia derwentensis	Terebratula (Dielasma) sacculus	
" tenuistriata	Deltopecten limæformis	
Lithodomus gouldii	" fittoni	
	Aviculopecten squamuliferus	
	Chænomya (Sanguinolites) etheridgii	
	Stenopora tasmaniensis	
	" crinita	
	Platycrinus ocula	

At Eaglehawk Neck the lower beds occur. The coarse grits and conglomerates form a level floor on the sea beach, with rectangular joints filled with oxide of iron. This is known as the Tesselated Pavement. The jointing is possibly due to the vicinity of a concealed body of intrusive diabase. At the Blow Hole, near the above, Mr. R. M. Johnston gives the following section:—

	Feet.
3. Yellow or white chalky mudstones with Spirifera glabra, Dielasma sacculus, &c.... about	150
2. Mudstone and calcareous sandstone, with Fenestella, Productus, Spirifera, Pachydomus, Platyschisma, Deltopecten, Pleurotomaria—about	60
1. Basal grits. Thickness not known.	

At the Middle Arm of the Tamar is a small development of the Lower Marine limestone resting upon the older Palæozoic rocks. The upper part represents characteristically the Fenestella zone, while the lower part contains Eurydesma in abundance.

On the Meander, near Cheshunt, the mudstones contain Spirifera, Productus, Dielasma, Pachydomus, Eurydesma, Pterinea, Deltopecten, Aviculopecten, Platyschisma, and Pleurotomaria.

Limestones occur in the Fingal Valley, at Marlborough, Eastern Marshes, and with the mudstones and conglomerates all round the borders of the Western and Central Tiers.

In the north-eastern part of the island, on the right bank of the River Piper, not very far from Lilydale, foraminiferal limestone—with Nubecularia stephensi (Howchin) and Spiroloculinæ—of this system has been found. The Lower Marine mudstones are exposed for a thickness of about 400 feet on the Jessie River, Preolenna, south of Wynyard. Below the coal of the Mersey (= Greta) horizon there fossiliferous mudstones come in for about 150 feet, containing Fenestella, Spirifera, Aviculopecten, Pachydomus, &c. These overlie non-fossiliferous mudstone, which extends down to the Jessie River, 200 feet or more.

In the neighbourhood of the Eldon Valley mudstones occur, with dwarfed varieties of Spirifera and Rhynchonella.

Round the base of East Pelion and Mt. Pelion are mudstone and limestone, with Fenestella, Spirifera, Productus, Aviculopecten, &c. Similar beds underlie the coal measures

on the Henty River, West Tasmania, yielding the following:—Spirifera tasmaniensis, Spirifera avicula, Spirifera convoluta, Chænomya, Fenestella internata, F. plebeia, Protoretepora ampla, Stenopora tasmaniensis.

At Port Cygnet the succession is:—(3) Fenestella zone; (2) Spirifera zone; (1) shaly mudstone. The fossiliferous sandstones occur all round Lovett and Lymington.

The Lower Marine beds in the Mersey basin have been disclosed by boring at Tarleton, where 105 feet of pebbly sandstone and conglomerate containing Permo-Carboniferous marine fossils rest upon Ordovician limestone. The organic forms are Stenopora tasmaniensis, Spirifera tasmaniensis, Fenestella plebeia, Dielasma sacculus, and Pleurotomaria morrisiana.

(2) The lowest beds of the upper division of the Permo-Carboniferous are the sandstones and shales which enclose the coal seams of the Mersey horizon. These correspond with the Greta series of New South Wales, and, like those measures, separate the Upper Marine series from the Lower Marine.

The Mersey coal measures consist of grits, sandstones, and marls, with seams of coal generally not exceeding 2 feet in thickness. The analyses of the coal from different collieries in the district are as follows:—

	Fixed Carbon.	Gases, &c.	Ash.	Moisture.
(1)	36·5	46·6	4·0	12·9
(2)	36·6	41·2	9·8	12·4
(3)	40·5	44·4	5·8	9·3
(4)	41·7	48·0	2·4	7·9

Remains of the vertebral column and ribs of a small amphibian(?) were found on the spoil heap from a shaft sunk near Railton in these measures.

The plant remains are the forms characteristic of the Permo-Carboniferous, viz.:—

Glossopteris browniana (Brongn.)
" ampla (Dana)
" indica (Schimper)
Gangamopteris angustifolia (McCoy)
" cyclopteroides (Feistmantel)
Noeggerathiopsis hislopi (Bunbury)
Phyllotheca australis (Brongn.)
Cardiocarpus sp.

In this basin, near the Great Bend of the River Mersey, near Latrobe, are beds of Tasmanite shale, consisting of sand and mud charged with oil-bearing vegetable spores,

and considered to be of value for the manufacture of lubricating and illuminating oils. The precise local relation which they bear to the coal seams is not known, but geologically they are on the same horizon. The fossils contained in these beds are as follows:—Spirifera tasmaniensis (Morris), Cardiomorpha gryphoides (de Kon.), Pachydomus hobartensis(?) (R. M. Johnston), Pleurotomaria morrisiana (McCoy), Pteronites latus (de Kon.), Aviculopecten sp.

At Preolenna, south of Wynyard, between the Flowerdale and Jessie Rivers, yellow sandstone and clays with seams of coal (with Glossopteris) attain a thickness of 250 feet. The proximate analysis of the coal, from seams varying from 20 inches to 3½ feet in thickness, ranges from 44 per cent. to 52 per cent. fixed carbon, 41 to 50 per cent. volatile matter, and 5 to 9 per cent. ash. Portions of these seams consist of kerosene shale or cannel coal, containing 76 per cent. gas and 21 per cent. fixed carbon. The coal-bearing beds are covered by fossiliferous mudstone, and rest on similar strata.

The beds of the coal measures series are developed on Mt. Pelion, Mt. Ossa, Mt. Oakley, at the north end of the Du Cane Range and on the Eldon Range. A seam of coal is known at Coal Hill, west of Lake St. Clair. The coal measure basin appears to deepen going south.

Near Barn Bluff is a seam of coal in a band of black micaceous shale, containing remains of Glossopteris and Noeggerathiopsis. The coal bed there rests upon conglomerate, and is overlaid by Permo-Carboniferous marine strata. A cannel coal similar to that at Preolenna has been found near Barn Bluff in loose blocks, supposed to be remnants of a wasted seam. Ice-action has been invoked to account for the breaking up of this seam.

On the north side of the Henty River, between the Henty and Badger, the lower coal measures are hard dark-grey shales, which contain Glossopteris browniana (Bngt.), Glossopteris ampla (Dana), Gangamopteris cyclopteroides (Feistm.), and Noeggerathiopsis hislopi (Bunbury)

At Harefield, in the Fingal coal basin, 97 feet of conglomerate, sandstone, and shale, with coal stains and impressions of a plant resembling Schizoneura, have been shown by boring to underlie beds belonging to the Upper Marine series.

(3) *The Upper Marine Series.*—In this are included the fossiliferous mudstones which overlie the Mersey coal

measures. Many of the organic remains in these are identical with those in the Lower Marine; some of the latter, however, have disappeared. The genera Fenestella, Spirifera, Dielasma (Terebratula), Pleurotomaria, Pachydomus, Aviculopecten, Cardiomorpha, Pterina, &c., have been recorded.

The upper zones of sandstone and shale at Porter's Hill, Hobart, correspond with the Upper Marine beds of the Mersey. Two hundred feet of these are exposed along the Derwent, containing, besides fragments of the plant Gangamopteris, the following forms:—Cythere tasmanicus (Johnston), Spirifera tasmaniensis, S. darwinii, S. duodecimcostata, Dielasma sacculus, Avicula, Arca, Aviculopecten, Eurydesma, Edmondia, Inoceramus, Pachydomus, Pleurotomaria, Conularia, &c.

At Harefield, in the Mt. Nicholas Valley, a bore revealed 313 feet of Upper Marine beds below the Mesozoic coal measures. These consist of sandstone, shale, conglomerate, and limestone, containing remains of Fenestella and other forms.

(4) The Mt. Cygnet and Adventure Bay coal measures may be taken as corresponding with the Newcastle series of New South Wales.

At Mt. Cygnet the measures rest on the Fenestella beds, and the coal seam, 3 to 4 feet in thickness, is enclosed in sandstone, which is occasionally pebbly. The proximate analysis of the coal is: fixed carbon, 63·9 per cent.; volatile matter, 13·2 per cent.; ash, 22 per cent. The shale of this seam contains impressions of Vertebraria australis and Gangamopteris spathulata.

At Adventure Bay, on Bruni Island, coal measure seams and shales lie comformably on the Lower Marine mudstones, &c. They contain dwarfed forms of Glossopteris browniana var. præcursor (Brgt.), Gangamopteris spathulata (McCoy), Gangamopteris obliqua (McCoy).*

(5) At Southport sandstones and shales rest upon conglomerate and pebbly sandstone, with marine shells. A diamond-drill bore reached the basal conglomerate beds at a depth of 500 feet. The recorded plant remains from the shales are Vertebraria australis and Pecopteris lunensis (Johnston).

(6) The alkaline rocks which form a N.E.-S.W. belt running from the Huon River through Port Cygnet to

* These forms of Gangamopteris are referred by Arber to G. cyclopteroides (Feistmantel). *Vide* "The Glossopteris Flora," by E. A. Newell Arber, 1905, pp. 104–5.

Woodbridge and Kettering are referred provisionally to the close of this period. It is definitely known that they are intrusive in the Lower Marine sandstones and mudstones, and they appear to be cut through by the diabase, which is considered to date from the close of the Mesozoic.

The belt comprises the following rock varieties: —

Alkali Syenites.	*Elaeolite Syenites.*	*Essexite.*
Quartz-augite syenite	Pyroxene foyaite	Essexite
Aegirine-augite syenite	Mica foyaite	
Alkali-syenite porphyry	Jacupirangite	
	Amphibole foyaite porphyry	
	Sölvsborgite porphyry	
	Mica sölvsbergite	
	Tinguaite porphyry	
	Monchiquitic nephelinite	

Auriferous quartz and pyrites have been developed near the line of contact of these igneous rocks with the Permo-Carboniferous sediments, and a good deal of alluvial gold has been recovered from the creeks and flats.

VII.—Mesozoic.

In Tasmania no essentially marine sediments are known to have accumulated in Mesozoic times. The process of retreat of the oceanic waters evidently persisted. Land plants, fish, and amphibian remains point to sub-aerial, fluviatile, and lacustrine conditions. The poverty of the fauna and the aridity of climate indicated by saliferous beds tend to confirm this view.

The lowest beds of this era rest conformably upon the Upper Permo-Carboniferous. The total thickness of the Mesozoic strata is tentatively estimated at about 1200 feet.

The intrusive sills of diabase which penetrated the Permo-Carboniferous strata forced their way also between the beds of this era, and as the upper coal-bearing beds have been affected in this way, it is evident that the diabase invasion took place at the close of the Mesozoic or in the early Tertiary.

Modern geological theory postulates a general shrinkage of the earth's mass upon its centre, and, as a consequence, the dominant movements are downward, not upward.

There has been, however, a greater relative sinking of the ocean floors (which are believed to have a higher specific gravity than that of the land areas). This subsidence is supposed to have been attended by a compression, and incidentally a raising of the continental segments. The

elevated land tracts subsequently proceeded to settle down to the level of isostatic equilibrium.

Possibly some diastrophic action of a minor character, and certainly the processes of base levelling, would also lower the surface of the land and bring about transgressions of the epicontinental seas. Finally, stresses would be developed, causing fracturing and faulting down the epicontinental platforms and margins of the land, and originating generally broad physical features identical with those which we see in our late Palæozoic and Mesozoic areas.

If this interpretation is correct, the huge step faults marked by the eastern escarpments of the diabase-capped central and eastern tiers can be explained. The successive tiers between the centre of the island and the eastern coast may be considered as successive steps leading down from the central "horst" to the coastal plains.*

The Mesozoic strata in Tasmania cannot as yet be broken up with any certainty into divisions corresponding with those of Europe, owing to the absence of stratigraphic breaks and adequate palæontological evidence. The utmost that appears possible for the present is to divide both stratified and igneous rocks into Lower and Upper Mesozoic, with a ternary subdivision of the lower group. Thus:—

(2) Upper Mesozoic—
  (iv) Diabase in intrusive masses, sills, or dykes.

(1) Lower Mesozoic—
  (iii) Fingal series or upper coal measures.
  (ii) Ida Bay series.—Sandstones and slates with coal at Ida Bay.
  (i) Knocklofty series—Variegated sandstones with Vertebraria indica (Royle),† remains of heterocercal fish and amphibians.

(i.) *Knocklofty Series.*—The sandstones at Knocklofty, the Domain, Tinderbox Bay, Sandy Bay, and probably at Ross, belong to this horizon. From the Cascades to Knocklofty are about 1000 feet of sandstone, from which the

* "In considering the coasts of Australia we must leave out of account the east coasts of Australia and Tasmania, which appear for many reasons to be a fractured margin of recent age, presenting no indications of negative movement"—The Face of the Earth: E. Suess, 1906 (Sollas' transl. Vol. II., p. 521).

† Arber has united Vertebraria australis (McCoy) with V. indica (Royle), "since there do not appear to be any good characters which clearly separate them" (Glossopteris Flora, 1905, p. 99).

remains of the fish Acrolepis hamiltoni (Johnston and Morton) have been recorded. These authors give the ascending section of the beds as follows:—

	Feet.
1. Yellow fissile sandstone	20
2. Flaggy sandstone with fish remains	5
3. Mottled shales with plants	60
4. Thick sandstone beds, quarried for building	715
	800

Sandstone near Tinderbox Bay is on the same horizon as the Knocklofty beds, and has yielded remains of a fish described by Messrs. Johnston and Morton under the name of Acrolepis tasmanicus. This sandstone overlies conformably the uppermost beds of the Permo-Carboniferous mudstones, as developed at Tinderbox Bay, Huon-road, and Waterworks Valley near Hobart.

This series of sandstones and shales contains the plant remains Vertebraria indica (Royle) [= V. australis. McCoy]. Vertebraria was discovered by Zeiller in 1896 to be the rhizome of the fern-like plant Glossopteris. In Tasmania it is restricted to the above series, and to the Southport beds.

Mr. Johnston considers the Lower Sandy Bay mudstones exposed 3 miles from Hobart on the Brown's River-road to be the base of the system. They contain obscure plant impressions.

The building stone at Ross probably belongs to this series of beds; as also possibly the saliferous sandstone of the midlands. Several salt pans occur on the estates of Mona Vale, Ballochmyle, Lower Park, and Ellenthorpe, in a chain extending for 7 miles N.W.-S.E. The individual lagoon beds or pans are from 1 to 100 acres in area. In dry seasons hundreds of tons of salt have been taken from them, and used for farm and domestic purposes. They were prized by the aboriginals, and were often the cause of tribal conflicts. Saliferous sandstone exists also near Richmond, on the Coal River 3 miles east of Colebrook, and reappears south of the town. Early settlers used to collect salt for household use from the caverns in this rock all along the line of the Richmond hills. Whether these saliferous sandstones belong to the Lower or Upper Mesozoic is a matter which needs investigating.

(ii) *Ida Bay Series.*—This comprises coal-bearing shale and sandstone at Ida Bay. About a mile south-west of the bay and 150 feet above sea-level are the coal-bearing beds. In the shales above the coal are impressions of Zeugophyllites* and Pecopteris lunensis (Johnston).

The beds of these two subdivisions of the Mesozoic are regarded as being on the horizon of the Narrabeen-Hawkesbury series of New South Wales (Trias.).

(iii) *Fingal Series or Upper Coal Measures.*—The upper coal measures of Tasmania are, from the affinities of their plant remains, considered to be on the Hawkesbury-Wianamatta horizon of New South Wales (Rhaetic?). The critical species for the Clarence measures, Tæniopteris daintreei (T. spathulata), has not been found in them. The only two forms of this genus hitherto discovered are T. tasmanica (Johnston) and T. morrisiana (Johnston). The most abundant plant impressions in these measures are those of Thinnfeldia odontopteroides, Alethopteris australis, and Zeugophyllites elongatus. The equisetal genus Phyllotheca is also common.

The Mesozoic coal measures of Eastern Australia have recently been transferred from the Trias-Jura to the Jura. Mr. W. S. Dun remarks†:—"It would appear advisable to (1) discontinue the use of the term Trias-Jura usually applied to this formation by Australian geologists; and (2) consider the Eastern Australian Mesozoic coal measures—characterised by the relatively great abundance of Tæniopteris daintreei (= spathulata), Alethopteris australis (= Cladophlebis denticulata), and numerous types of conifers and Thinnfeldia, together with the Lake Eyre beds, as Jurassic."

In accordance with this the Ipswich formation in Queensland, the Clarence measures and Talbragar fish beds in New South Wales, and the South Gippsland and Otway coal measures in Victoria, all of which contain Tæniopteris daintreei, are now assigned to the Jurassic system.

The Wianamatta, Hawkesbury, and Narrabeen beds have not yielded this plant, nor have the Tasmanian Mesozoic measures. The evidence certainly is negative, and consequently inconclusive. For the present, however, the

* Zeugophyllites elongatus (Morris) has been transferred by A. C. Seward to the genus Phœnicopsis of Heer. See Arber: Gloss. Flora, p. 183. On the other hand Dr. F. Kurtz includes it under Podozamites elongatus (Morris), Feistm. Q. J. Geol. Soc. 1903, p. 25.

† Geol. and Min. Resources of the Western Coalfield, by J. E. Carne, Mem. Geol. Sur. New South Wales, 1908, p. 42.

whole of the Mesozoic groups of strata in Tasmania are regarded simply as Lower Mesozoic. The Knocklofty beds appear to correspond lithologically with the Hawkesbury sandstones. The upper coal measures have been looked upon by English authors as Rhaetic.

The strata occupy discontinuous areas, which are separated from one another by intrusive masses of diabase. Much faulting occurs. They occupy positions varying from sea-level to nearly 3000 feet above the sea. Their vertical thickness, as observed, is not less than 1200 feet, and probably exceeds this. They lie horizontally or at low angles, usually not exceeding 10° or 20°. Lithologically they are yellow, brown, greenish, and bluish-grey sandstones, frequently markedly felspathic, alternating with grey or bluish-grey shales.

The coalfields probably at one time belonged to one basin, but as they are now disconnected, it is convenient for purposes of reference to class them geographically in separate divisions. The following division embraces the different fields: —

Northern—

(1) Longford basin.

Southern—

(2) Colebrook (Jerusalem) and York Plains basin.
(3) Ouse basin.
(4) Derwent and Richmond basin.
(5) Huon basin.
(6) Recherche basin.

South-Eastern—

(7) Schouten and Spring Bay basin.
(8) Tasman Peninsula Basin.

Eastern—

(9) Fingal basin.
(10) Llandaff and Douglas River basin.

(1) *Longford Basin.*

The upper coal measures crop out near Norwich from below the sediments of the Launceston Tertiary area, and apparently succeed the fringe of Permo-Carboniferous marine strata which skirt the northern face of the Western Tiers. The coal seams have a thickness of 3 to 4 feet.

(2) *Colebrook (Jerusalem) and York Plains Basin.*

The Mesozoic strata fringe everywhere diabase-crowned hills. At York Plains sub-anthracitic seams of coal up to 4 feet in thickness occur in these beds. The coal assays 60 to 67 per cent. fixed carbon, 13 to 14 per cent. gas, and 16 to 23 per cent. ash. At Colebrook bluish-grey sandstone overlies a seam of coal 2 feet thick; and other seams up to 3 feet have been met with.

At Green Ponds horizontal beds of these sandstones have been preserved. At Mike Howe's Marsh, 17 miles north-west of Oatlands, soft yellow sandstones dip north-westerly, and contain coal assaying 62 per cent. fixed carbon, 18 per cent. gas, and 10 to 11 per cent. ash.

(3) *Ouse Basin.*

The strata of this coalfield comprise soft yellowish-brown felspathic sandstones and grey shales with characteristic fern impressions. The general dip is to the west, at an angle of about 3°. Fragments of silicified wood are frequent. Seams of coal from 2 to 5 feet thick exist at this horizon. Analyses show from 53 to 63 per cent. fixed carbon, and 21 to 25 per cent. volatile matter. Below the coal-bearing sandstones are a series of siliceous or quartzose sandstones, corresponding with the freestones quarried at Knocklofty, Ross, &c. The coalfield is nearly encircled by igneous rocks—by basalt to the north-west and diabase on the north-east, east, and south.

(4) *Derwent and Richmond Basin.*

Mesozoic sandstones and shales flank the ranges round Mts. Wellington, Direction, and Dromedary, along the valley of the Derwent between Hobart and Bridgewater, and again between Bridgewater and Richmond.

Coal-bearing beds of shale and sandstone are met with round New Town, where they repose on the grey and yellow building stone, the beds of which belong to the Knocklofty series. The coal shales contain plant impressions characteristic of the upper coal measures, the most abundant forms being Alethopteris australis (Morris), Thinnfeldia odontopteroides (Morris), and Neuropteris tasmaniensis (Johnston). Zeugophyllites elongatus (Morris) and the common species of Phyllotheca also occur.

North of Mt. Direction sandstones of this division carrying coal dip gently towards the west. The associated shales

contain impressions of Thinnfeldia, Phyllotheca, and Zeugophyllites.

(5) *Huon Basin.*

Felspathic sandstones and shales occur on the divide between the Huon and North-West Bay River basins. They contain several coal seams from 1 to 6 feet in thickness, and have a general dip to the north-west at angles varying from 5° to 10°. These seams are known as the Sandfly group. The assays range from 50 to 56 per cent. fixed carbon, 25 to 30 per cent. volatile matter, and 15 to 17 per cent. ash. An anthracitic seam also occurs, assaying 80·8 per cent. fixed carbon, 8 per cent. volatile matter, and 9 per cent. ash. The crowns of the hill ridges consist of diabase.

(6) *Recherche Basin.*

The Upper Coal Measures occur in a belt of country flanking Recherche Bay, and continuing across Catamaran River to South Cape Bay.

At the head of Recherche Bay is the settlement of Leprena, and south of this the coal measures form the coastal range, which rises to 900 feet and dip in a north-westerly direction. They extend also to the east side of the bay. The outcrops of the coal on the range are about 200 feet above sea-level. The coal contains, by assay, 54 per cent. fixed carbon and 26 per cent. volatile matter.

North of the Catamaran River the coal-bearing sandstones and shales contain Thinnfeldia odontopteroides, var. obtusifolia, Zeugophyllites elongatus, and Phyllotheca australis, and continue across the river to the south, where some coal has been found overlaid by shale and white sandstone. The shale carries impressions of Thinnfeldia odontopteroides.

The Catamaran coal assays 67 per cent. fixed carbon and 25 to 27 per cent. volatile matter, and under 4 per cent. ash.

The same beds crop out along the coast-line between South and South-East Capes, containing identical plant remains and trunks of silicified conifers.

(7) *Schouten and Spring Bay Basin.*

The Prosser's Plains and Spring Bay strata consist of white or yellow freestone, of good building quality and the usual greenish-grey or yellowish felspathic sandstone. The freestone seems to overlie the felspathic variety, which, in

its turn, overlies the coal, at any rate round Spring Bay. Much false bedding prevails, but a main gentle northerly dip of one or two degrees exists. Coal seams up to 5 feet in thickness occur at Triabunna. At Prosser's Plains are seams of coal dipping to the south-west, at high angles (40°).

On the north shore of Schouten Island a seam of coal was worked at one time by the Imperial Government. This is associated with fireclay enclosed in soft carbonaceous sandstones and shales.

(8) *Tasman Peninsula Basin.*

The Mesozoic rocks, yellow and white sandstone and blue and grey shales, with coal seams, flank the diabase-capped ridges of the northern part of the peninsula, and form low cliffs on the coast-line. Some of the coal seams were at one time worked extensively by the Imperial Government. The north-easterly extension of these shales at Dunalley has yielded numerous plant remains, which have been determined by R. M. Johnston as follows:—

Pecopteris buftoni (Johnston).
Pecopteris caudata (Johnston).
Thinnfeldia buftoni (Johnston).
Thinnfeldia polymorpha (Johnston).
Macrotaeniopteris wianamattae? (Feistm.).
Gleichenia dubia (Feistm.).
Trichomanides spinifolium (T. Woods).
Neuropteris tasmaniensis? (Johnston).
Ptilophyllum oligoneurum (T. Woods).
Pterophyllum, sp.

(9) *Fingal Basin.*

At one time this plainly embraced all the measures between Ben Lomond and Mt. Nicholas in the north, and Llandaff in the south, though continuity has since been interrupted by diabase intrusions. The limits of the field are quite arbitrary, as continuity southwards can be established indefinitely. The Mt. Nicholas Range rises to a height at the trigonometrical station of 2800 feet above sea-level, and consists of about 1000 feet of coal measure sandstone crowned by columnar diabase. This descends below the valley-floor for over 200 feet, and rests upon the Upper Marine beds of the Permo-Carboniferous system, giving about 1200 feet of vertical thickness for the Upper Coal Measures here.

Strong coal seams are being worked on the south flank of the range. A section of the range at the Cornwall Mine would give approximately the following succession in descending order: —

	Feet.
Diabase—about	300
Coal	6
Sandstone	200
Coal	4
Sandstone	250
Coal	20
Sandstone	70
Coal	6
Clay	4
Coal	8
Sandstone	15
Clay	7
Coal	9
Coal measures sandstone to floor of valley	480

Recent assays of the coal worked at the large Cornwall and Mt. Nicholas collieries are as follows: —

	Moisture.	Hydro-Carbons.	Fixed Carbons.	Ash.
(1)	6·50	26·30	57·70	9·50
(2)	7·48	26·14	58·36	8·02
(3)	8·72	23·10	58·88	9·30
(4)	8·60	18·20	61·40	11·80
(5)	6·66	21·48	56·76	15·10

Several unworked seams occur at different horizons all round the mountain. The Mesozoic strata continue westwards to Fingal, and thence along the valley of the South Esk to St. Pauls, Ben Lomond, Mt. Rex, and Avoca. Southwards from Mt. Nicholas they extend south in a coastal belt down the eastern shore-line. Mt. Logie (Elephant) south of St. Marys forms a north and south ridge a mile long, capped with diabase and fringed with Mesozoic sandstone and Permo-Carboniferous sandstone. Beyond this to the east granite stretches away to the coast-line. Further south are coal seams near Thompson's Marshes, in the usual soft greenish-grey felspathic sandstones.

Avoca township is on Tertiary basalt, below which are Tertiary sediments resting upon Mesozoic sandstone and Permo-Carboniferous limestone. At Mt. Rex and on the

Bona Vista estate are strong seams of coal 6 to 12 feet in thickness. The coal analyses of the Mt. Rex seams are:—

Moisture.	Hydro-carbons.	Fixed Carbons.	Ash.	Sulphur.
1·2	35·0	54·5	8·5	0·8
1·7	28·2	55·0	15·1	—
—	38·2	52·9	8·9	—

(10) *Llandaff and Douglas River Basin.*

Strictly speaking, this is a continuation of the Fingal area, but is so far south as to justify geographical separation. The diabase-capped mountain range parallel with the coast near Bicheno and Seymour is flanked by Mesozoic sandstones up to 800 or 900 feet above sea-level; and above this diabase ascends for about 300 feet further. These sandstones have been shown by sinking and boring to descend to a depth of at least 350 feet below sea-level. The horizons are, however, affected by faults, so as to render an estimate of thickness difficult. The coal-bearing beds consist of yellowish-green felspathic sandstone and shales, with fossil imprints of Thinnfeldia odontopteroides (Morris). They have a gentle inclination to north-west and south-west. The seams of coal vary in thickness from 2 to 12 feet, and the quality is also variable. The good qualities range from 50 to 57 per cent. fixed carbon and 27 to 34 per cent. volatile matter.

The following is R. M. Johnston's list of Tasmanian Mesozoic plants:—

	Upper Coal Measures.	Ida Bay.	Lower Sandstones.	Remarks.
Ferns.				
Alethopteris australis (Morris)	1	...	...	=Cladophlebis denticulata (Brongn.) var. australis (Morris)
„ serratifolia (Johnston)	1			
Cardiopteris tasmanica (Johnston)	1			
Cyclopteris (or Salisburia) australis (*Johnston*)	1			
Gleichenia dubia (Feistm.)	1			

	Upper Coal Measures.	Ida Bay.	Lower Sandstones.	Remarks.
Glossopteris moribunda (Johnston)	1	...	...	Lord's Hill, New Town
Macrotaeniopteris wianamattae (Feistm.)	1			
Neuropteris antipoda (Johnston)	1			
„ tasmaniensis (Johnston)	1			
Odontopteris crispata (Johnston)	1			
Pecopteris buttoni (Johnston)	1			
„ caudata (Johnston)	1			
„ lunensis (Johnston)	...	1		
„ odontopteroides (Morris)	1			
Rhacophyllum coriaceum (Johnston)	1			
Sagenopteris tasmanica (Feistm.)	1			
Sphenopteris morrisiana (Johnston)	1	...	...	
„ flexuosa (McCoy)	1	...	...	Considered by Arber as = S. lobifolia
„ germana (McCoy)	1	...	...	
„ hastata (McCoy)	1	...	...	
„ lobifolia (Morris)	1	...	...	
„ plumosa (McCoy)	1	...	...	
„ alata (Brongn.)	1			
„ elongata (Carruthers)	1			
„ tasmanica (Johnston)	1			
Strzeleckia gangamopteroides (Johnston)	1			
„ tenuifolia (Johnston)	1			
Taeniopteris morrisiana (Johnston)	1			
„ tasmanica (Johnston)	1			
Thinnfeldia buttoni (Johnston)	1			
„ feistmantelii (Johnston)	1			
„ obtusifolia (Johnston)	1	...	...	Considered by Shirley as = T. odontopteroides
„ media (T. Woods)	1			
„ polymorpha (Johnston)	1			
„ superba (Johnston)	1	...	...	Considered by Shirley as = T. odontopteroides
„ trilobita (Johnston)	1			

	Upper Coal Measures.	Ida Bay.	Lower Sandstones.	Remarks.
Trichomanides spinifolium (T. Woods)	1			
,, ettingshauseni (Johnston) ...	1			
Equisetaceous Plants.				
Annularia australis (Morris) ...	1			
Phyllotheca australis (Brongn.)	1			
,, hookeri (McCoy)	1	...	...	Considered by Arber as = P. australis
,, ramosa (McCoy)	1			
Lycopods.				
Lepidostrobus muelleri (Johnston)	1			
Cycads.				
Podozamites distans ? (Presé)	1			
Pterophyllum dubium (Johnston)	1			
,, risdonense (Johnston)	1			
,, strahani (Johnston)	1			
Sphenozamites feistmantelii (Johnston)	1			
Ptilophyllum oligoneurum (T. Woods)	1			
Conifers.				
Baiera tenuifolia (Johnston) ...	1			
Ginkgophyllum australe (Johnston)	1			
Salisburia hobartensis (Johnston)	1			
Zeugophyllites elongatus (Morris)	1	1		
Affinities uncertain.				
Cryptophyllites tasmanicus (Johnston)	...	...	1	
Vertebraria australis (McCoy...	...	...	1	United by Arber with Vertebraria indica (Royle)

(c) The close of the Mesozoic or beginning of the Tertiary was marked by an extensive irruption of basic materials in the form of intrusive sheets and dykes of diabase, which have penetrated all the rock-systems earlier than Tertiary. The rock is of fine to medium grain, of typically hypabyssal structure, and is composed essentially of pyroxene and lime-soda felspar. The general absence of olivine is one of the most useful field criteria for distinguishing the rock from Tertiary basalt. The following are two analyses of the rock from the north and the south of the island respectively, made by Professor Ditrich and Dr. Pohl:—

	Enstatite-augite-bearing Diabase from Launceston.	Quartz, or Konga Diabase from North-West Bay.
SiO_2	52·49	56·74
TiO_2	0·62	1·26
Al_2O_3	16·44	15·46
Fe_2O_3	2·60	3·08
FeO	5·30	7·58
MnO	trace	trace
MgO	6·18	2·54
CaO	11·71	7·64
Na_2O	2·06	3·08
K_2O	1·09	1·59
H_2O under 110°	0·15	1·28
H_2O above 110°	1·42	
P_2O_5	trace	0·15
	100·06	100·40

It should be mentioned that the quartzose variety, though frequently met with in the south of the island, is not quite typical for Tasmanian diabase. All the signs of the occurrence of diabase in Tasmania indicate its intrusion into overlying rocks. Its base is not glassy, but rather a felspathic mesostasis; the rock is never scoriaceous, has no horizontal partings between separate lava flows as in basalt, and is sometimes almost gabbroid in texture. The numerous dykes injure the quality of the coal in their proximity, and affect adjoining sandstone and shale by converting the former into quartzite, and the latter into chert or adinole. Most of the coastal headlands in the south-east and west are composed of diabase. In the North they form the promontories at Cape Portland, Tamar Heads, Port Sorell Point, and Mersey Bluff. Over half the island, from the central tableland to the east and south-east, the dissected and faulted country

exposes everywhere sections of the great diabase sills, from which their former Permo-Carboniferous or Mesozoic covering has been removed by erosion. Outliers of the Eldon sill exist as far west as Mts. Sedgwick and Dundas, which are capped by this rock, and there is a dyke or other intrusion at Mt. Heemskirk. While no doubt exists of its invasion of the Permo-Carboniferous and Mesozoic strata, its actual relations to them in the field are frequently obscure, owing to the contacts being more often than not concealed.

VIII.—Tertiary.

A great stratigraphic break exists between the Mesozoic and the sediments of the Tertiary system. While it is very likely that the time divisions of the Cainozoic era adopted in Europe and America rest upon basic principles of world-wide applicability, it does not at present seem possible to adopt in Tasmania other than a binary classification.

(*b*) *Neogene or Upper Tertiary* (= approximately Pliocene)—

(4) Terrace drifts and clays overlying basaltic lavas.

(*a*) *Palæogene or Lower Tertiary* (= Miocene to Eocene)—.

(3) Basalt lavas.

(2) Fluviatile and lacustrine clays and sands. Gold and tin-ore drifts and deep leads. Lignitic clays and leaf beds.

(1) Marine beds at Wynyard, Montagu, Cape Grim, and Heathy Valley, Flinder's Island.

The oscillations of the land surface in the north are difficult to follow. A Pre-Eocene land connection with the continent is considered to have existed; then followed an Eocene depression. At some time in the early Tertiary the land in northern Tasmania must have been higher than now; but prior to the Mid-Tertiary basalt eruptions a prolonged subsidence was in progress, when the clays and gravels of the Launceston basin were laid down as deposits reaching a thickness of 1000 feet. Subsequently many valleys were filled with lava sheets. In Post-basaltic or Pliocene times a rising movement again set in, which restored the Bassian land bridge for a time. The changes of level, however, finally left the floors of the deep leads at Beaconsfield, Lefroy, Back Creek, &c., still below sea-level at their outlets.

In southern Tasmania the indented shore-line of the estuary of the Derwent indicates drowned valleys descending seawards. The leaf beds on the shores of the Derwent have been depressed to below sea-level, and bear witness to late Tertiary or Quaternary advance of the sea on the land.

For the most part, Tasmanian Tertiary deposits are non-marine. In other parts of the world the Tertiary is known as the age of lakes, and this island offers no exception, for lacustrine and fluviatile deposits of the period are the prevailing ones. In them are preserved leaf impressions and remains of extinct deciduous trees, *e.g.*, oak, elm, beech, &c., together with eucalyptus, banksia, cinnamon, and various conifers. Examples of these deposits are the lacustrine or estuarine beds of the valley of the Derwent and of the Launceston Tertiary basin. Other deposits fringe existing rivers or were the beds of ancient streams, as along the South Esk and the deep auriferous and stanniferous leads at Lefroy and in the Ringarooma district.

(1) *Marine Beds at Wynyard, &c.*

At Wynyard, on the west side of the mouth of the River Inglis, are beds of fossiliferous limestones of Eocene age. The Sandy Cove bluff, rising to a height of about 170 feet, consists of stratified rocks about 80 feet in thickness, overlaid by about 80 feet of the basaltic lava, which commonly separates the Lower and Upper Tertiaries.

The fossiliferous series comprises a Crassatella bed at the base only a few feet thick and superincumbent Turritella beds nearly 80 feet in thickness. These are heavily charged with marine shells and corals, of which 316 specific forms have been identified. The Turritella beds have yielded impressions of leaves of Pteris Belli, Sapotacites oligoneuris (Ettingsh.), besides remains of an extinct marsupial, Wynyardia bassiana (Spencer).

The species of Turritella which have been identified are:—

T. warbutonii (T. Woods), abundant.
T. sturtii (T. Woods).
T. tristira (Tate).
T. conspicabilis (Tate).
T. acricula (Tate).
T. murrayana (Tate).

And of Crassatella:—

Crassatella (Crassatellites) oblonga (T. Woods).
Crassatella communis (Tate).
Crassatella aphrodina (T. Woods).

These beds repose horizontally on the Permo-Carboniferous glacial beds of the Wynyard formation, which dip north-westerly at low angles up to 10°.

At Cape Grim polyzoan limestone in horizontal beds, dipping eastward under basalt, composes the sea front on the West Coast, immediately south of the cape. These beds extend eastwards to the Welcome River. Besides polyzoa, they contain Tertiary echinoderms and brachiopods.

On Flinders Island, near the Patriarchs at Heathy Valley, is a Lower Tertiary shell limestone with marine shells, some of which (Cucullea, Nucula, Turritella) resemble forms found in the Eocene beds at Wynyard.

(2) *Derwent Tertiary Basin.*

The valley of the Derwent exhibits a series of Tertiary sands and clays bordering the present river. They indicate the former existence of lacustrine conditions in the lower Derwent. These beds attain a maximum height of 40 or 50 feet above sea-level, and may be seen at One-Tree Point, Sandy Bay, Cornelian Bay, Lindisfarne Bay, Geilston Bay, &c. At Pipeclay Bluff, Cornelian Bay, where the beds rest horizontally on diabase, the white pipeclay contains remains of the fruit Plesiocapparis leptocelyphis (Mueller) and impressions of various leaves. These strata probably extend below the basalt at the Cemetery Bluff, and correspond in age with the infra-basaltic beds of the Launceston Tertiary basin.

At Geilston Bay beds of clay and limestone (known as the Geilston Travertin) occur, containing the following:—*

Helix geilstonensis (Johnston).
Helix huxleyana (Johnston).
Helix sinclairoides (Johnston) or (H. sinclairi, Pfr.).
Vitrina barnardii (Johnston).
Bulimus gunnii (Sowerby)
Cypris alburyana (Johnston)

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* *Fide* R. M. Johnston in Geol. of Tasmania, p. 285

These beds constitute a fragment of the floor of the ancient lake of the Derwent, and were once continuous with corresponding deposits on the west side of the estuary. The preserved flora of the Derwent Tertiaries is characteristic of the Palæogene in Tasmania, viz., leaves of betula, alnus, quercus, fulgus, salix, cinnamomum, araucaria, sapotacites, with the fruits platycoila, penteune, conchotheca, plesiocapparis, cordia, &c.

Higher up the Derwent, near its confluence with the Styx River, are beds of light-coloured clay associated with lignite, apparently derived from conifers. Near Glenora clay leaf-beds occur below the basalt, yielding leaves of fagus and cinnamomum. Near the Ouse bridge the river flows through Tertiary beds of lignite and clay, containing large tree trunks.

Launceston Tertiary Basin.—This comprises the wide plain within the drainage area of the Tamar and its tributaries. It contains layers of irregularly bedded sandstones and clays, often with lignite. These cover an area of 600 square miles, and attain a thickness of 1000 feet. The plateau has a general height of 500 to 600 feet above sea-level.

The lowest beds are, perhaps, those between Muddy Creek and Supply River, on the Tamar, where a series of horizontal ferruginous sands and white and bluish clays occurs, dipping slightly to the north-west, the lower strata containing Anodonta tasmanica (Eth. fil), Unio johnstoni (Eth. fil), and numerous leaf impressions (Cordia tasmanica, Ettingsh., and Premna drummondi, Ett.).

In the auriferous lead at Brandy Creek, Beaconsfield, 270 feet below sea-level, a stratum of black carbonaceous clay has yielded the Palæogene fossil fruits Spondylostrobus smythii (Mueller), Platycoila sullivani (Mueller), Plesiocapparis leptocelyphis (Mueller), Cordia tasmanica (Ettingsh.), Elaeocarpus bassii (Ett.), Penteune allporti (Mueller), Conchotheca turgida (Mueller), and leaves of cinnamomum polymorphoides (McCoy); also large trunks of conifers. Similar beds occur at Dilston and Windermere on the east bank of the Tamar. Lignitic beds of Tertiary clays and sands occur east of Mt. George.

The false-bedded sandstones of the Windmill Hill and Sand Hill, Launceston, are Upper Palæogene. They contain leaf imprints of deciduous and other trees (betula, fagus, quercus, cinnamomum, banksia). At Carr Villa, near Launceston, the boring core showed an impression

of a betula leaf, at a depth of 500 feet. Leaf-beds appear on the railway-line at Breadalbane, with lignite impressions of banksia, betula leaves, &c.

A bore at Belmont went down in the Palæogene sandstone and shale to 894 feet without reaching bottom. This is equivalent to about 200 feet below sea-level. The common leaf impression, Betula launcestoniensis, was found.

North-East.—In the north-east the high plateau of sand and gravel, with alluvial tin ore, near Branxholm and Derby, which is capped with basalt, marks the ancient course of the Ringarooma River before it was choked with lava and diverted to its present channel. At Gladstone, the old Mussel Roe stanniferous lead contains fossil wood.

East.—Tertiary leaf-beds also occur in the tin-ore drift in Thureau's Deep Lead, at St. Helens. At Tullochgorum in the valley of the South Esk, sandy clays, with lignite, have yielded fossil leaves similar to those at Muddy Creek.

North-West.—Palæogene alluvial beds occur on the North-West Coast below the basalt sheet which caps the coastal plateau. At Burnie, in a white pipeclay below the basalt, imprints of leaves of European and other types have been found. At Waratah leaf imprints have been obtained from greyish Tertiary sandstone beneath 45 feet of basalt, at a height of 2000 feet above sea-level. These leaves have been identified as follows:—Eucalyptus kayseri (Johnston), Laurus sprentii (Johnston), quercus bischoffensis (Johnston), Ulmus tasmanicus, Cycadites microphylla (Johnston).

West.—Leaf-beds of similar age, and containing impressions of Cinnamomum polymorphoides (McCoy) and Sapotacites oligoneuris (Ett.) also occur in the carbonaceous clays and ferruginous sands which form horizontal beds along the shores of Macquarie Harbour from Strahan to Pillinger. The lower beds form a lignitic series, in which leaf forms belonging to the Lauraceæ and Cycadaceæ are found. At Farm Cove, near Pillinger, beds contain fossil resin.

At the Henty River are lignite beds, with remains of leaves, Fagus jonesii (Johnston) and Acacia meiringii (Johnston).

(3) *Basalt Lavas.*

Towards and at the end of, the Palæogene, a great outpouring of basaltic lava took place in nearly all parts of

the island. This rock is the effusive expression of a gabbroid magma. Its mineral components are lime-soda felspar and pyroxene, with or without olivine. It is here, however, usually olivine-bearing. The olivine mineral is extremely abundant in some varieties, generally in rounded or corroded crystals, but occasionally with perfect crystal form, as in the hyaline lavas of Sheffield. Every variety of structure and condition is represented. In some parts of the island the basalt is highly vesicular (*e.g.*, Conara, Benham Plains, Bothwell, Waratah, Hampshire, &c.). Tachylyte, or basalt glass, with a weathered crust of a beautiful blue colour, occurs at Richmond and Nietta. Columnar structure is common, as at Burnie and other places. On the North-West Coast the basalt occasionally assumes a limburgitic (felsparless) facies, as at Wynyard, on the Wilmot-road, south of Hamilton-on-Forth, and in a dyke on the Emu Bay railway-line, 7 miles from Burnie.

No cinder cones have been observed, but crateriform cones or plugs occur, *e.g.*, east of Lake Sorell, and on the Shannon Tier. The extensive basaltic sheets probably issued from fissures rather than from the more familiar cone vents. The lava choked the river valleys towards the close of the Palæogene, sealing up stanniferous and auriferous gravels, and protecting deep leads, which are now worked for gold and tin.

Some of the basalts belong to the alkaline division of igneous rocks, *e.g.*, at Table Cape, Shannon Tier, and at Sandy Bay, Hobart.

The coarse basalt which forms the promontory of Table Cape, a bold headland near Wynyard, rising 580 feet above sea-level, is composed of labradorite, augite, olivine, abundant apatite, and iron oxide with analcime. Nepheline has been identified in it by Prof, Rosenbusch, who considers that the rock belongs to the trachydolerite group. A similar basalt forms the promontory of the Nut, at Circular Head.

On the Shannon Tier are some small volcanic cones (Haystack, Beehive, Anthill) consisting of melilite—nepheline basalt, erupted through the diabase which crowns the tier. A coarse nepheline-augite rock is associated with the finer grained basalt, but both probably form a geological unit. The constituents of the basalt are nepheline, melilite, olivine, pyroxene, perofskite, apatite, and magnetite. Dr. F. P. Paul's analyses of this rock* are as follows:—

* Foyaitisch-Theralithische Gesteine aus Tasmanien. Dr. F. P. Paul, Vienna, 1906, p. 37.

	I.	II.	III.
SiO_2	36·17	37·96	33·89
TiO_2	2·15	2·93	0·64
Al_2O_3	11·88	10·14	9·93
Fe_2O_3	11·37	3·69	15·63
FeO	4·17	7·59	—
MgO	14·22	14·69	16·14
CaO	11·54	16·28	15·19
Na_2O	5·38	2·18	2·86
K_2O	2·07	0·69	—
H_2O	—	1·82	2·90
P_2O_5	0·84	1·13	1·41
ZrO_2	—	—	—
CO_2	—	—	1·41
MnO	trace	0·22	—
Cr_2O_3	—	0·08	—
V_2O_3	—	0·05	—
NiO	—	0·04	—
SrO	—	0·05	—
BaO	—	0·06	—
SO_3	—	0·03	—
S	—	0·04	—
Cl	—	—	—
	99·79	100·13	100·00
Specific gravity	3·147	3·150	3·04

One variety of the Shannon Tier rock has been determined by Dr. Paul as nepheline-eudialyte basalt, in which the mineral eudialyte takes the place of melilite as an essential constituent. Dr. Heidenreich's analysis of this rock is as follows:— *

SiO_2	36·03
TiO_2	1·13
ZrO_2	0·21
Al_2O_3	15·19
Fe_2O_3	5·94
FeO	9·55
MnO	0·17
MgO	8·60
CaO	15·52
Na_2O	4·23
K_2O	1·85
P_2O_5	1·38
Loss on ignition	0·58
	100·38
Specific gravity	3·079

* Dr. F. P. Paul, *ibid*, p. 44.

A melilite-bearing nepheline basalt occurs at the Alexandra Battery, Sandy Bay, near Hobart. Its constituent minerals are nepheline, olivine, pyroxene, melilite, apatite, and magnetite. Dr. Paul has detected in it a little orthoclase and cossyrite. The iron olivine fayalite crystals are visible to the naked eye as red spots in the rock. An analysis of this rock by O. E. White and W. A. Macleod* gives its composition as follows:—

SiO_2	47·21
Al_2O_3	16·06
Fe_2O_3	11·87
FeO	1·43
CaO	7·34
MgO	0·12
K_2O	2·40
Na_2O	7·51
Ignition loss	2·55
	99·49
Specific gravity	2·81

IX.—Quaternary.

This comprises the Pleistocene and Recent periods. The main topographical features of Tasmania during this era were essentially the same as exist to-day. There were the same mountain ranges, the river systems, the central plateau, the western highlands. Tasmania has remained insular throughout the era.

Since Pleistocene times the north-western part of Tasmania has apparently suffered an uplift relative to sea-level, evidenced by the existence of extensive elevated peneplains. These are strikingly evident along the northern coast and in the west of the island, between the ocean and the West Coast range. The recent river systems, rejuvenated by the upward crustal movement, have deeply dissected the area, and seamed it with profound gorges.

Some further change of strand level has taken place subsequently, producing raised beaches on the northern coast and in the islands of the straits. Dune formation has been in progress along the coast lines; terrace drifts show the deepening of channels by existing streams; ossiferous cave breccias have been formed on the floors of caves and in fissures in the Ordovician limestone. Moraine material was transported into valleys by glaciers on the high ranges

* Notes on a Fayalite Basalt from One-Tree Point. Proc. Roy. Soc. Tas. 1898-1899, p. 78.

in the western and central parts of the island. Finally man appeared, and in the course of time, the indigenous race became extinct.

The Quaternary may be divided as follows, but in view of the difficulty of establishing a sequence, it would be unsafe to rely implicitly on the order of succession. Some of the events in the separate divisions may have been actually contemporaneous.

Recent—

(6) River alluvium and sand dunes. Native shell beds.
(5) Raised beaches.
(4) Helicidæ sandstone.

Pleistocene—

(3) Glacier indications in the Western highlands.
(2) Cave deposits.
(1) Pebble and terrace drifts.

Pleistocene.

The Pleistocene period in Tasmania, though not distinguishable by any remains of characteristic organic forms, shared with other countries the climatic features of a glacier epoch. Although Pleistocene glaciation affected the northern hemisphere more profoundly, it was nevertheless a world-wide phenomenon, and the southern hemisphere was not wholly exempt. Tasmania was not buried under a general ice sheet like that which covered Europe and America: no evidence has been discovered of any glaciation in the eastern part of the island, but glaciers unquestionably were developed in the highlands of the west where none exist to-day.

(1) *Pebble and Terrace Drifts.*

At different levels in the large river valleys, terraces of drift were formed which were cut down into later by the rivers as their channels deepened. These are relics of the flood plains of the past. Examples are present in the valleys of the Derwent, North and South Esk, and Gordon rivers. Drift beds of this age occur in various river valleys, containing pebbles of silicified coniferous and other wood, and relics from Palæogene leaf-beds.

(2) *Cave Deposits.*

In Pickett's cave, in the Chudleigh district, a number of sub-fossil bones have been found on the stalagmitic floor,

and in crevices of the Ordovician limestone. These belonged to existing species of kangaroo, kangaroo rat, wallaby, wombat, opossum, &c.

(3) *Glacial Deposits.*

Evidences of the Quaternary glaciation of the highlands are abundant on the mountains of the west and on the elevated plateau of north-western Tasmania. Glaciated rock surfaces can be traced on Mts. Tyndall and Sedgwick to near their summits. The lakes between the western ranges are bordered by moraines. On the western slopes of the West Coast Range numerous moraines occur. The township of Gormanston is on beds of glacial boulder clay of this age, which have been cut through by the Linda Creek. Sections of these beds are exposed in creek banks between the Gormanston Gap and the Linda township. Glacial deposits continue for miles down the valley of the King River. Erratics in the Mackintosh valley and the notable moraines on the Cradle Mountain and Barn Bluff plateau belong to the same age. The plateau between Mt. Pelion and Barn Bluff is characterised by the prevalence of low, rounded hummocks and numerous tarns or lakelets. On the slopes of Barn Bluff are lines of moraine ridges, and from here towards Granite Tor rolling hummocks still occur. Erratics and glaciated surfaces are features of the country round Lakes Dixon and Undine, and on the Frankland Range. On the west side of the Craycroft Range moraine material with large boulders occurs at a height of about 250 feet above sea-level. All round the promontory west of Farm Cove, Macquarie Harbour, moraine boulder material is present at sea-level. From the Denison Range an immense number of ice-borne conglomerate boulders have been carried down and spread over the valley of the Gordon River, and from their disposition with reference to existing topography it may be inferred that the glaciers were active in Quaternary times. The same conclusion may be drawn from the glacial deposits on the north-western plateau, which are well preserved, with fresh-looking rock scorings, and are evidently of an age subsequent to the establishment of the existing configuration of the country.

(4) *Helicidæ Sandstone.*

A shelly sandstone, consolidated dune sand, or arenaceous limestone occurs on most of the islands in Bass Straits (Cape Barren, Badger, Green, Chappell, and Kan-

garoo Islands) up to 100 feet above sea-level, resting in horizontal beds on the granite or older stratified rocks. Its organic remains are shells belonging to various living species of Helix, Bithynella, Succinea, Pomatiopsis, Physa, Bittium, Truncatella, &c. Bithynella nitida (Johnston) is doubtfully distinct from an existing form, and Helix simsoniana (Johnston), found in the white calcareous sandstone or limestone of Kent's group, is not known as a living species in Tasmania.

On Flinder's Island, 2 miles up the River Arthur, and 30 feet above sea-level, is an oyster bed with untravelled shells, suggestive of alteration of level.

(5) *Raised Beaches.*

These are on the same geological horizon as the helicidæ sandstone. They exist all along the northern coastline, and on the Straits Islands. Some of them on the latter underlie the consolidated sand dunes (helicidæ sandstone), and are found 40 or 50 feet above sea-level. Elevated beaches of marine shingle are seen at the mouths of the Blythe and Emu Rivers, and elsewhere, on the shore of Bass Straits. In the extreme south-west of the island, at Cox's Bight, the flat marsh land along the coast indicates a slight elevation of the country there within the recent period.

(6) *Native Shell Beds.*

Comminuted burnt shells are found in heaps and layers several feet thick at various points on the coast-line and on the shores of estuaries. associated with worked aboriginal flakes. These are the Kitchen middens of the extinct Tasmanian race, and are deposits of, perhaps, greater interest to the ethnologist than to the geologist. The last of this race (Truganini) died in Hobart in May, 1876. When and how woolly-haired negritoid man entered Tasmania is a debatable question. It has been generally supposed that he crossed from Australia before Bass Straits were formed, but if the last separation of the island from the mainland took place as far back as the Pliocene this supposition would involve a greater antiquity for man in Tasmania than is suggested by the insignificant tribal divisions and the superficial nature of the deposits in which remains of his handwork are found.

ORE-DEPOSITION.

It is a question whether some ore-deposition (copper) is not connected with the porphyroid or granitic eruption of Cambrian age, but undeniably the period during which the deposition of most of our ores was active was the interval between the Upper Silurian and Permo-Carboniferous. Ore-deposition of this period was associated principally with the consolidation of the Devonian gabbroid and granite masses. Nickel sulphide and iridosmine owe their origin to serpentine at the Heazlewood, Trial Harbour, and Dundas. The granite magma is responsible for the silver-lead lodes at Zeehan, the tin and wolfram lodes all over the island, and for the gold quartz reefs of Beaconsfield, Lefroy, Mathinna, &c. A few barren quartz veins occur in the Permo-Carboniferous strata, but outside the exceptional alkaline porphyries at Port Cygnet, the chapter of metal-bearing lode action closed with the Devonian period. Within the term between the Cambrian and Devonian were deposited the great stores of mineral which the mining industry of Tasmania is now drawing upon. The mines of gold, silver, lead, copper, and tin rank among the famous mines of the world. When the small area of the island (26,000 square miles) is considered, her mineral wealth may be regarded as remarkable.

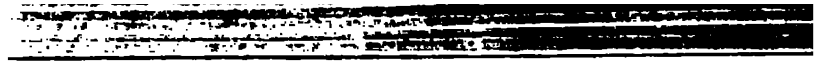
THE GEOLOGICAL SUCCESSION IN TASMANIA.

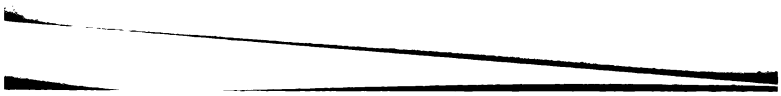
Group.	*System.*	*Representative Formations.*
QUATERNARY	RECENT	1. River alluvium and sand dunes. Native shell beds. 2. Raised beaches. 3. Helicidae sandstone of the Straits Islands
	PLEISTOCENE	4. Glacier indications in the western highlands 5. Cave deposits at Chudleigh 6. Pebble and terrace drifts
TERTIARY	NEOGENE	7. Terrace drifts and clays overlying basaltic lavas
	PALAEOGENE	8. Basalt lavas 9. Fluviatile and lacustrine clays and sands. Gold and tin ore drifts and deep leads. Lignitic clays and leaf beds 10. Marine beds at Wynyard, Montague, Cape Grim, and Heathy Valley, Flinders Island
MESOZOIC	UPPER MESOZOIC	11. Diabase in intrusive masses, sills, or dykes
	LOWER MESOZOIC	12. Fingal series or Upper Coal Measures 13. Ida Bay series. Sandstones and shales with coal at Ida Bay 14. Knocklofty series. Variegated sandstones with Vertebraria indica (Royle), remains of heterocercal fish and amphibians

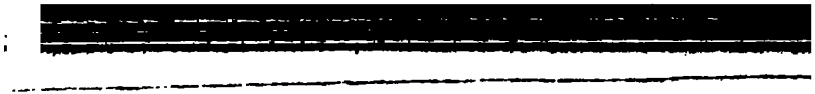
THE GEOLOGICAL SUCCESSION IN TASMANIA—continued.

Group	*System.*		*Representative Formations.*
PALAEOZOIC	PERMO-CARBONIFEROUS	UPPER	15. Elaeolite and alkali syenites, with various alkaline porphyries, at Port Cygnet and along D'Entrecasteaux Channel. (Precise age unsettled.) 16. Southport sandstones and shales 17. Mt. Cygnet and Adventure Bay sandstones and shales 18. Upper Marine mudstones overlying Mersey coal: Porter Hill shales and sandstones, Sandy Bay 19. Lower Coal Measures (= Greta horizon, New South Wales); Mersey Basin, Preolenna, Henty River; Tasmanite beds
		LOWER	20. Conglomerates, grits, limestones, and Lower Marine mudstones throughout the south-east, north-east, north-west, and midlands; glacial conglomerates, grits, micaceous sandstones, and slaty flagstones in thick beds form the base of the system
	DEVONIAN		21. Granite, aplite, granite porphyry usually associated with previously consolidated gabbros and peridotites
	SILURIAN		22. Eldon Valley clay slates 23. Fossiliferous limestone, sandstone, and slate at Zeehan, Heazlewood, Queen and Nelson Rivers, Lorinna, &c.

		Railton, Mole Creek, Beaconsfield, &c.
	CAMBRIAN	Insertae sedis 26. Dundas slates and breccias; the Dial Range and Leven slates, breccias, tuffs, and porphyroids; a similar series at Zeehan; the felspathic porphyries of Mts. Lyell, Jukes, Darwin, and the West Coast Range generally. 27. Slate and sandstone at the Needles and in the neighbourhood of Mts. Mueller and Wedge 28. Dikelocephalus sandstone at Caroline Creek and the Florentine Valley 29 Discoidal sandstone in the Loddon River Valley and at Caroline Creek, near Dulverton 30. Tubicolar sandstone at Middlesex, Five-mile Rise, Mt. Claude, Lemonthyme Hill, Black Bluff, Zeehan, Loddon River Valley. 31. Conglomerates, pebbly sandstone, and quartzite on the West Coast Range, Mt. Zeehan, the Thumbs, Denison Range, Railton, &c.
PRE-CAMBRIAN	ALGONKIAN	32. Amphibolites of the Rocky River; garnet-zoisite-amphibolites of Hamilton-on-Forth and the Collingwood River Valley 33. Quartzitic, sericitic, graphitic, and argillaceous schists and schistose conglomerates of the Frenchman's Cap, Prince of Wales Range, Cox's Bight, Port Davey, Barn Bluff, Ulverstone and Forth, Rocky Cape, Long Plain, Asbestos Range
	ARCHAEAN	Not yet found *in situ*.







THE MOUNT FARRELL MINING FIELD.

[Four Plans.]

I.—INTRODUCTION.

(1)—General.

In the Mt. Farrell mining district, with which this bulletin deals, the writer has been allotted, for purposes of geological examination, a field which has recently attracted no little public interest.

The district can hardly be said to be a new one. It is rather a field to which the prospector has returned with fresh vigour.

The North Mt. Farrell Mine has been exploited with ever-increasing energy, and its output has been materially increased within the last few months. The faith thus expressed in the future of that property has done much towards the general expansion of the mining industry throughout the district.

The favourable condition of the metal market during the year 1907 also materially aided the work of prospecting; and, as a result, during the early months of 1907 there were floated two new propositions on the southern side of the Murchison River, viz., the Tullah and Thomas' Blocks; also, the first-discovered silver-lead mine of the district, T. H. Farrell's old reward claim, was reopened under the name of the White Hawk.

Besides these properties, which are being actively prospected, there have also been discovered other occurrences of ore at both the northern and southern ends of the field. The future of these latter discoveries will depend very largely on the success of the present prospecting operations.

During my visit to the field two fresh finds were made; and this fact serves to indicate that the district is still receiving the active attention of prospectors.

The position of Mt. Farrell—at the northern end of a series of districts notable for their mineral wealth—is also such that additional interest is attached to its geological examination.

The attempt has been made to define the features common to these several districts, so that they may serve as an indication that, where they recur, prospecting work may reasonably be expected to meet with reward; and

this portion of the results of a geological examination must be that which is of more permanent value and wider interest. Special attention has therefore been given to the genesis of the lodes, the general types to which they conform, and their relation to the rock-formations of the district.

(2)—Geographical Position.

Mt. Farrell is situated at the point where the Murchison and Mackintosh Rivers unite to form the Pieman River. The latter finds its outlet to the ocean on the western coast of the island.

Measured in a direct line, the mining field is 35 miles from the coast-line, and it is about 4 miles east of the Emu Bay Railway line.

Mt. Farrell is situated north and a few points eastward of the main West Coast range, of which the culminating peaks are known as Mts. Darwin, Jukes, Huxley, Owen, Lyell, Sedgewick, Tyndall, Read, and Murchison.

The metalliferous belt of the western coast is found to follow closely the trend of the mountain range. The mining fields have therefore a meridional trend; and Mt. Farrell is the most northerly of a series of districts in which copper, gold, silver-lead, and zinc are represented by their several ores. From its geographical position, therefore, the district of Mt. Farrell demands considerable attention.

The only means of communication at present is by the Emu Bay Railway line. A horse tramway connects with the railway at a point 21 miles south of Guildford Junction. However, there is now in course of construction a steam tramway, which, when completed, will materially shorten the present route to the Emu Bay Company's line, and provide a more efficient means of transport to the mining township.

II.- PREVIOUS REPORTS ON THE FIELD.

The first occasion on which an official visit was paid to the field was in the early part of the year 1895, when Mr. A. Montgomery, then Government Geologist, passed through the northern portion of the district, and visited the properties now known as the Tullibardine and the White Hawk Mines.

It was Mr. Montgomery who gave the name of Mt. Farrell to the "rugged rocky range" (up to that time unrecorded), as a tribute to the undaunted endurance of the pioneer prospector of the district- T. H. Farrell.

At the time of Mr. Montgomery's visit no mineral discoveries had been made on the slopes of Mt. Farrell itself.

The report, therefore, of that gentleman on the area contains only his notes on the two properties above mentioned, and some short references to the general geology of the district.

In June, 1900, Mr. Twelvetrees made a short inspection of the district and the mines which were at that time in active operation. His visit was of only one week's duration, and necessarily too brief to admit of any detailed examination of the geology of the area. This report, which contains detailed accounts of the condition of the several mines at that period, is dated from the Government Geologist's Office, on 20th December, 1900.

The next visit paid to Mt. Farrell by a member of the geological survey staff was in March, 1904, when Mr. G. A. Waller made a brief examination. Mr. Waller's remarks on the general geology of the district are of great value, on account of his intimate acquaintance with the geology of the other mining fields of the West Coast range.

Mr. Waller draws attention to the fact that at Mt. Farrell there are found members of the same rock types as occur along the main axis of the West Coast range in an unbroken line from Mt. Darwin northwards. He suggests that the schistose igneous rocks of the district be termed "porphyroids," after the strikingly similar schistose porphyries of Europe. Of this matter more will be said later, when the rocks are treated of.

With regard to the massive conglomerate which forms the main mass of the ridge of Mt. Farrell itself, Mr. Waller's remarks are of particular interest. This formation has been studied by him in several localities on the West Coast, and he concludes that it should be referred to the base of the Upper Silurian. Formerly, it had been considered that the conglomerate was of Devonian age. Of this, also, further mention will be made in a later portion of this report.

III.—PHYSIOGRAPHY.

(1)—Topography.

The topography of the area is due primarily to the forces which have tilted up the strata to high angles, and secondarily to the natural denuding agencies which have developed the rugged outlines of the surface.

The ridge known as Mt. Farrell is long and very narrow, and owes its character to the nature of the central hard band of siliceous conglomerate. This weather-resisting formation rises at the top of the mountain abruptly from the softer rocks with which it is in contact to a maximum height of about 1600 feet above the junction of the Mackintosh and Murchison Rivers.

The outlines of the surrounding heights are different. Mt. Black, to the west, has well-rounded outlines, and the spurs spread out into the valleys on all sides. Mt. Murchison, which towers above all the surrounding country, shows a series of abrupt cliff faces, with long-graded slopes stretching away on either side.

To the west of the Mt. Farrell ridge lies a broad alluvial plain, which runs back far up the valley of the Sterling River, which occupies the depression between Mt. Murchison and Mt. Black. Its northward continuation is the valley of the Mackintosh River, which joins the Murchison at Mt. Farrell, and flows away westward towards the coast as the Pieman River.

Again, on the eastern side of the Mt. Farrell razor-backed ridge, lies a broad flood-plain—that of the Sophia River—which gathers in the waters of the White Hawk Creek, and joins the Mackintosh River at the northern extremity of Mt. Farrell.

The Murchison River differs from these other rivers in that it has cut its way right through the conglomerate ridge, and now makes its way north and west to join the Mackintosh a little below its junction with the Stirling.

The area drained by these rivers is very considerable, and they are never dry, although the variations in the amount of water passing along their channels are considerable with the seasonal changes.

At Mt. Farrell the average river level is a little over 100 feet below the flat surface of the button-grass plain which marks the old level of the flood-plain.

The region has been elevated since the establishment of this flood-plain, and the river systems are still actively engaged in once more cutting down their beds to the base level of corrosion.

The ancient flood-plain of the Mackintosh River affords some evidence to prove that the uplifting of the region was not effected by one simple movement, for there are still traces of two river terraces left in the undenuded river wash at a point a little north of the town, and west of the Mackintosh Mine.

On the steep banks, also, of the White Hawk Creek, above the old workings of T. H. Farrell, there are terraces of this old river wash.

This elevation of the country is not restricted to the particular region in question, for there are raised beaches at several points on the West Coast. At Strahan, the Tertiary beds are known to form raised beaches, and numerous terraces of gravel are recorded. Mr. Montgomery, in his report on the Corinna Goldfield in 1894, claims that these gravels are of marine origin. However, whether of fluviatile or marine origin, the present elevated position of these gravels is indisputable proof of elevation. It may be that the period of this upward readjustment was Post-Tertiary, and followed upon a Tertiary subsidence. Raised beaches of recent sediments have been recorded at Cox's Bight by Mr. Twelvetrees,* and it may be that some parts of the western portion of Tasmania are still undergoing elevation.

The age of the alteration of level in the Mt. Farrell area is not to be definitey determined from the evidence now available.

There is some evidence in the district which may be regarded as indicative of glaciation. In the neighbourhood of the White Hawk Mine there are very large rounded boulders of granite to be seen. These have been undoubtedly derived from the Granite Tor mass, but are now some miles distant from their source. They may possibly have been rounded in beds of the mountain torrents, but they now occur stranded high above the present creek beds. I noticed several on the flanks of Mt. Swallow, 1000 feet above the level of the White Hawk Creek bed at the mine.

These boulders certainly have the appearance of glacial erratics, but no other of the phenomena usually to be seen in glaciated areas were noticeable.

Mr. R. M. Johnston, in his paper entitled "The Glacier Epoch of Australasia,"† correlates the evidence of these boulders with that of the moraines, roches moutonnées, &c., of many other places to prove a former glaciation of the western highlands of Tasmania.

Taken in conjunction with other evidence, it may be admitted that these rounded boulders are true glacial erratics, and that the region has been subjected to ice action, yet the topography of the area has not been

* Report on Cox's Bight Tinfield, December, 1906.

† Royal Society of Tasmania, 1893.

seriously modified by such ice action. If other traces of glaciation were impressed upon the district they have since been obliterated by the action of other surface agencies, unless perhaps Lake Herbert represents a rock basin gouged out by the ice action.

The topography, therefore, of the Mt. Farrell district as a whole is that of an elevated region in which the erosion cycle has once reached maturity, but of which the features are now suffering a more rapid alteration, for a comparatively recent alteration has taken place in the general level of the district, and in consequence the river systems have been rejuvenated.

(2)—METEOROLOGY.

The rainfall at Mt. Farrell is undoubtedly very heavy, although no statistics can be adduced to give an idea of the actual amount of precipitation. The following figures, taken from Walch's Tasmanian almanacs, show the total rainfall for a period of 12 months at some of the principal points on the West Coast of Tasmania.

Mt. Read is quite close to Mt. Farrell, but its elevation is considerably greater.

Total Rainfall 1st October to 30th September.

	1899-1900	1900-1901	1901-1902	1902-1903	1906-1907
Mt. Read	—	—	77·91	83·61	126·95
Zeehan	101·33	106·00	94·50	105·31	100·33
Mt. Lyell	94·48	131·20	114·53	118·71	117·23
Waratah	88·03	90·33	73·3	94·48	109·40

The township of Mt. Farrell is said to possess a milder climate, and a drier one, than other spots on the West Coast, on account of its sheltered position. Nevertheless the annual rainfall is considerable, and is not very evenl distributed. The winter and spring are said to be tl wettest seasons, while from the middle of December un March fairly fine weather is prevalent.

Of this rainfall, during the rainy seasons by far t greater proportion must run off the steep surface slopes the rivers. The snow that caps the highest peaks lin for a time, and then augments the supply of water to mountain torrents.

Some small proportion of the rainfall must be held tinuously by the surface mantle of soil and peaty gro The so-called "button-grass" plains and slopes retain

dampness long after the rain has ceased by the action of this vegetable growth; otherwise, the return of the rain to the rivers is rapid, and the rise of a river is to be noted almost instantly after the rain has been observed to fall.

This heavy rainfall on a country of steep slope must necessarily cause a very considerable amount of rock-waste to be carried away downhill to the rivers, and prevent the accumulation *in situ* of any weathered rock-masses. The only retarding agent tending to arrest this downhill movement is the dense vegetation of the district, which exerts a strong binding influence on the surface-mantle of soil; and in the case of the button-grass growth, the whole of the underlying material is covered and protected from the denuding agents.

On the western slopes of Mt. Farrell the whole surface-soil can be seen to be creeping downhill where sections of the surface-soil are exposed by the numerous trenches cut there. The cleavage planes of the slates, which dip to the west in the undisturbed ground a foot or two below the surface, are seen at the surface dipping to the east. The slate is soft and cleavable, and it has been pushed so far by the general soil-creep that the dip of its cleavage planes is inverted.

(3)—The Effect of the Topographic Features on Mining.

Prospecting and Exploitation.—On the whole, the topography of the district may be said to be very favourable to the exploitation of the mineral belt. The steep grade of the western slopes of Mt. Farrell along which the mineral belt runs has indeed prevented the accumulation of the rich gossanous material which often caps the silver-lead lodes of other mining fields. In fact the downward soil-creep has in many cases quite covered up all traces of an outcrop, although the lode lies only a few feet below the present surface.

But the creeping surface-soil forms only a very shallow layer, since it is removed almost as soon as it forms, so the prospector has not much overburden to remove in most cases when trenching for the lodes.

The creeks cut across the country on these western lodes, and have therefore aided the prospecting of the main portion of the field very considerably.

On the other hand, on the south side of the Murchison River, the streams, on the whole, flow in a more northerly direction as they leave the northern slopes of Mt. Murchison, and run with the strata, rather than across; yet the

Tullah lode was picked up in a stream flowing westward from the slopes of Little Farrell.

Both the White Hawk Mine and the Tullibardine owe their discovery to the existence of these natural sections afforded by the creeks.

The Murchison River itself has cut across the rock-formations and laid bare several occurrences of ore, both of lead and of copper, to which reference will be made later.

Once located, the lodes have been readily exploited by adits driven into the sides of the mount; and these adits, driven towards the central core of the mountain, are usually nearly at right-angles to the strike of the lodes. The north Mt. Farrell Company owes the discovery of its "No. 1 lode" to its lowest level adit, which intersected this body of ore, which does not extend upwards as far as the surface. In fact, the aid afforded to mining by the physical configuration of the country will be apparent when it is remembered that there is not a shaft on the field that serves for the raising of ore to the surface.

Water-supply.—The narrowness of the ridge at the top of Mt. Farrell, and the steepness of the slopes, cause one serious drawback. In consequence of the small area exposed, and the rapidity with which atmospheric moisture leaves the mountain sides, the rainfall, heavy though it is, is, on the whole, insufficient to supply the needs of a mining community of the size of Mt. Farrell, if dependence is to be put only upon the rainfall on the western slopes of the mount.

At the present time there are only two concentrating mills on the field, and of these one is inactive.

The North Mt. Farrell Company's mill is supplied with water issuing from the underground workings of its own mine, and the Mackintosh; but this is inconsiderable in amount. The supply is augmented by a pipe-line that has been constructed to the top of the mount to carry down the waters of the small lake on the southern crest of the ridge. This lake is of small extent, covering only 10 acres, and its catchment area is also small, so that the present demands on its contents are all that can be met. The dry season of the year, for about three months after Christmas time, renders this lake supply a doubtful one for a plant in continuous action.

Races are cut to tap the several streams on the mountain side, but these, too, are apt to fail in the dry season, and the water from underground alone is left.

As regards the mines situated away from the Mt. Farrell ridge: On the south side of the Murchison River

no concentrating is being done at the present time. In the event of developments underground warranting a milling plant, the machinery site will undoubtedly be chosen on the banks of the river. And indeed any concentrating mill of the future will need to be built on the river banks or in immediate proximity thereto.

As regards the White Hawk and Tullibardine properties, the water-supply offers no difficulty, should operations at these mines create the demand.

Power.—The configuration of the country is such that, were the quantity of water sufficient, all necessary machinery could be actuated by hydraulic power.

The North Mt. Farrell Mine utilizes its lake supply to drive a 9-foot Pelton wheel, and generates thus a part of the power necessary for driving the concentrating machinery. The lake supply is conveyed from the syphon by pipes and races to the top of the ridge, and thence descends direct in a pipe to the mill. At present this pipe is not full to the top, so that the available head could not be ascertained. A reservoir chamber is needed at the top of the ridge of such capacity that it can carry enough water to maintain a full head for the two shifts during which the mill is running.

The White Hawk Mine is very favourably situated as regards both water-supply and the available head at which it could be delivered with small expense, for the White Hawk Creek drains a large area of country and descends to the mine by a very steeply-graded gorge with several waterfalls.

IV.—GENERAL GEOLOGY.

(1)—The Rock Types represented on the Mt. Farrell Field.

The various rock formations which require description will be treated of under three heads—

(*a*) The igneous rocks.
(*b*) The sedimentary rocks.
(*c*) The metamorphic rocks.

A.—THE IGNEOUS ROCKS.

There are several groups of igneous rocks on the field, each of which must be looked at separately.

(1).—*The Porphyries and their Associates.*

The first group to be considered is the acid-intermediate series, of which so many different facies are present. These are all gradations from the granitoid varieties

south-east of the main ridge of Mt. Farrell, to the porphyries and felsitic types further westward. On consideration of the many features shared in common by all these types, I feel convinced that they are to be taken together as one geological group.

The Holocrystalline Types.—The track from Mt. Farrell along the eastern bank of the Murchison River to the sections in the south-east affords several exposures of a medium-grained basic granite, or syenite, which merges by insensible gradations into a green porphyritic felsite, to be described later.

This syenite—showing to the naked eye equidimensional constituent crystals of dark-green biotite mica and hornblende, pink orthoclase felspar, and the pale greenish felspathic mineral, with an indistinct cleavage—appears like a granite, but the poverty of quartz in the rock is plainly apparent.

Microscopically the rock appears to be a fairly normal syenite, altered by dynamical stresses and masked by reconstitution. The hornblende still remains here and there in idiomorphic crystals, but most of it is altered, and its place taken by chlorite and epidote. The same alterations have taken place in the case of the biotite. In one section I noticed a mineral which appeared to have been augite, but was almost wholly altered into chlorite.

The felspars are clouded by kaolinization, and the plagioclase more so than the orthoclase. The latter has a faint reddish tinge in thin sections. As regards the exact member of the plagioclase series present, I was unable, through the decomposition of the rock, to obtain satisfactory extinction angles.

Quartz is present here and there in graphic intergrowth with the orthoclase. Apatite is common in stout unaltered idiomorphic crystals.

In crystallization, the plagioclase seems to have preceded the hornblende, while the orthoclase was subsequent to it.

The crushing has subjected all the minerals to a state of strain, and has even produced actual fracturing in many cases. Where the minerals have withstood crushing without actual rupture, and where they remain sufficiently undecomposed, their extinction is "shadowy" or "wavy."

These rocks are found in the southern and south-eastern portions of the field, at the Osborne Blocks, and at Kitson's. On the Section 2940, in the name of H. J. Kelly, a variety occurs that may be termed a true granite, from the greater prevalence of quartz.

The Felsitic and Porphyritic Types.—Intercalated with the sedimentary rocks all through the district are a series of porphyritic rocks which appear to me to correspond in general composition to the holocrystalline members above described, but to have consolidated under different physical conditions. By a series of chemical analyses this matter could be settled, but in the meantime the question cannot be definitely decided.

The southern portion of the field will, by reference to the geological map, be seen to consist very largely of these rocks, which form broad zones or very narrow bands in the slate.

From point to point their mineralogical constitution can be seen to alter even in the same continuous belt of rock. A felspar porphyry thus can be traced into a quartz porphyry or into a fine-grained felsitic rock wherein no crystals can be distinguished by the unassisted eye, and the texture is quite homogenous.

Variations in the structure are equally gradual. The uncrushed rocks are comparatively easily distinguished without miscroscopic aid, but in the field these simple types are found to merge into the schistose varieties so gradually that no divisional line can be drawn between the crushed and uncrushed portions; and uncrushed blocks of irregular lens-like shapes occur, quite surrounded by the crushed types.

Again, in the field one is often in doubt as to whether the cleavable schist under observation belongs to the igneous series, or whether it is a variant of the associated sedimentary rocks. In such cases the weathered surfaces of the schist afford some information, since the quartz crystals of the rocks, which were originally unmodified quartz porphyries, often resist the weathering agents that gradually disintegrate the rest of the rock, and so stand out in relief. In this way I found several doubly-terminated quartz crystals left in relief on weathered faces or edges.

By weathering these rocks have their appearance considerably altered in most cases. The aspect of the massive varieties is least affected, and the surfaces are clean and smooth where there is no surface-soil above. At one point, on Section 2864, the progress of weathering on the massive rock, which has an elaborate system of small joint planes developed in it, has produced a rude spheroidal structure.

In some localities, notably near the mouth of No. 4 tunnel on the North Mt. Farrell Mine, and a little to the

east of the Langdon Mine, the rock weathers to a honeycombed aggregate, which has all the appearance of a lava with its vesicular cavities caused by the expansion of imprisoned gases at the moment of solidification. Some specimens were so full of these cavities as to resemble a pumice.

It is on evidence such as this that the conditions under which the rocks solidified are to be determined. That is to say, it is possible to judge whether these felsites and porphyries were true *effusive* rocks which poured out on the surface as lava flows, or whether they were *intrusive* rocks which forced their way between the other rocks which were already formed, by the observation of these peculiarities.

By the microscope it can be shown that these felspar porphyries near the North Mt. Farrell workings carry filled vesicular cavities. These are apparent on weathering as empty elongated spaces. The unweathered rocks show in this section these vesicles filled with calcite chlorite, and often a layer of chalcedonic silica.

The vesicles thus filled are considerably elongated, but always in one general direction. This evidence, when taken together with that of the presence of fragmental igneous rocks (to be described later), seems to me to point with certainty to the existence of volcanic action within but a short time of the period of sedimentation, during which the slates were formed.

None of these vesicular rocks were observed to the east of the slate series. They are always on the western side; and on Section 3263 at least the igneous rock was clearly intrusive into the slate, for tongues of the igneous rock can be seen protruding into the slate.

The western boundary of the slates would therefore seem to have been, in all probability, on the horizon of the former surface. The original surface is now tilted to a high angle by subsequent warping.

The effusive rocks which poured out on this surface would then be the surface representatives of the plutonic syenites and granites, and the intrusive porphyries.

A further sign of rapid cooling, such as would take place at the surface, was noticeable in the rocks close to the horizon of the tuff. In one thin section the microscope reveals a ground-mass of extremely fine grain, showing a considerable number of roughly concentric cloudy markings. These are, in my opinion, caused by the progress of weathering along the perlitic cracks caused by

the rapid cooling of a rock, once glassy, but since devitrified.

The schistose varieties of this igneous series weather to a grey rock with a very rough surface, especially where the edges of the planes of schistosity are exposed. The uneven hardness and resistance to solution are the causes of the rough surface, and on these weathered edges it is sometimes possible to distinguish uncrushed idiomorphic crystals of quartz.

One feature of some persistence, and especially noticeable wherever the schistose igneous rocks are found, is the occurrence of very numerous veinlets of quartz traversing the members of this series in every direction. The quartz is often coloured pink, and the veins consist in many instances of small crystals, whose longer axes are at right-angles to the length of these numerous intersecting cracks. The width of these veins of crystalline and massive quartz is small, the great majority being under half an inch wide, and very seldom are veins of over an inch met with. The silica has not been deposited solely in the veins, for it has in many instances thoroughly impregnated the rock, and caused it to assume the character of a chert.

This silicification, which is evidently of later origin than the rocks in which it forms so prominent a feature, took place after the main crushing of the region had been effected. For the veinlets are usually undisturbed in the schistose varieties of the porphyries. It is true that there are several occurrences of the fracturing and contortion of these veins, and in some cases I found the quartz crystals of the vein-filling deformed by a movement of the walls to which they are attached. However, these cases are exceptional. The elaborate fracturing of the porphyries may have been caused by the crushing forces which induced the schistosity, but the filling of the fractures with silica was for the most part of later date.

Microscopically these rocks show many features of interest, and of value in determining their relationships.

The massive porphyries display best the original mineral constitution of these rocks, for the development of the schistose structure has been attended by a reorganization of the molecules, and the original character is very largely masked.

The phenocrysts most common in the least altered types are of quartz and plagioclase felspar. Orthoclase felspar is present but not common, and of the plagioclase series the more acidic members are the ones commonly found.

Sericitization and mechanical deformation have in many cases made it impossible to determine the felspar which is present. But the low values for the extinction angles, when measured from the albitic lamellæ, render it clear that the plagioclastic felspars are commonly of the composition of oligoclase. Secondary albite is often present in small clear crystals in the reconstituted ground-mass.

The orthoclase is more frequent where quartz is present in addition to the felspathic phenocrysts.

In no cases are the felspars quite fresh, and they are frequently almost completely replaced by sericite or a quartz-albite aggregate.

The quartz appears sometimes with its crystal outlines well developed, but has more usually suffered corrosion by the magma, and has its boundaries embayed. Very seldom is the quartz free from the "shadowy" extinction consequent upon a state of strain.

Ferromagnesian minerals are rare, and never free from alteration; but in one specimen collected from near the Tullah town-side there was well defined hornblende only slightly chloritized. I also noticed a mineral, which may have been a pyroxene, present in the felspar porphyry of the Langdon section. In a few slides there are chloritized remains of a mineral which seems to have been biotite before its alteration.

Epidote is common all through the series, and is usually to be seen in granular aggregates.

The ground-mass is sometimes little altered, and is a fine-grained micro-felsitic aggregate, which has corroded its way into the phenocrysts.

There is no visible sign of fluxion, save for a slight tendency of the felspars to arrange themselves with their longer axes in one general direction. The quartz phenocrysts, being more equidimensional, do not exhibit any such tendency. The proportion of phenocrysts to ground-mass is very variable.

The crushed varieties of these rocks are clearly of this group as regards origin, when seen in thin sections, however widely their microscopic characters may vary from those of the typical porphyries.

The chief variation introduced by the crushing is the development of a wavy banding throughout the rock. This closely resembles the fluxion structure often visible in this class of rocks, due to a movement of the magma during the process of crystallization. Here, however, the uncrushed types show no such fluxion structure in any of the thin sections prepared for examination, and the

banding is, in my opinion, of later date than the solidification, and due to dynamic stresses.

In the much-crushed types the phenocrysts have been shattered, and the fragments drawn out into *augen*, or they show signs in polarized light of being in a condition of considerable physical strain. The ground-mass becomes entirely changed into a quartz-albite-sericite aggregate, in which the sericite is strung out in wavy zones, and in some varieties a considerable amount of calcite is present in addition.

Chlorite is also common, especially in the rocks associated with the holocrystalline varieties at the Osborne Blocks and near Kittson's. It is sufficiently abundant to impart a deep green tint to the rock, which resembles anything but a quartz porphyry to the unaided eye. The chlorite in thin sections is strongly coloured, and is extended in wavy lines in much the same way as the sericite of other varieties.

Summing up the evidence collected with regard to these rocks, we may say that they all belong to one series of intrusives and effusives.

Their mineral composition indicates that they are not, in very many cases at least, typical quartz porphyries and felspar porphyries, but rather quartz keratophyres and keratophyres; for there is an almost constant predominance of the sodic over the potassic felspars.

With the description given here of the rocks of Mt. Farrell it will be interesting to compare the notes of Messrs. W. H. Twelvetrees and W. F. Petterd on "The Felsites and Associated Rocks of Mt. Read and Vicinity."*

Many of the rocks there described are identical with those from the Mt. Farrell district—occurring, as they do, in one continuous belt with these.

The crushed varieties of these keratophyres may well be termed "porphyroids," since they correspond in all respects to the rocks originally thus named in Germany. In fact, Professor Rosenbusch, the eminent petrologist, after examining some of the rocks of Mt. Read, has written:—†

"Undoubtedly we have here strongly dynamically altered forms of the acid eruptive rocks. The typical porphyritic structure, the nature of the phenocrysts, the still-recognisable fluidal structure, the nearly entire absence of dark constituents, the occasional spherulitic

* Proc. Roy. Soc. Tas., 1898-9, pp. 33-46.

† *Ibid.*, p. 43.

forms still recognisable in their replacement products (quartz, albite), all point with certainty to members of the quartz porphyry family, and, with great probability, not to quartz porphry in the narrower sense, but to quartz keratophyre and keratophyre. . . . The rocks greatly resemble our German occurrences in Westphalia, the Fichtelgebirge, and Thüringen, and especially the occurrence in Wales. These are the forms which in Germany were originally called porphyroids and flaserporphyries."

Mr. Waller, in his report of 1904, proposed the term "porphyroid" for the schistose rocks of this series. It has been adopted, to some degree, by the mining community, but is used quite without discrimination. The present detailed description of the schistose porphyries has been given in order to give a greater degree of definition to the term "porphyroid," and to indicate clearly the exact meaning of this word, which is used in the later portion of this bulletin. The rock is an important one in the Mt. Farrell mining field, and with the slates forms the common country rock of the lodes. Associated here and there with the green quartz porphyries of the Osborne Blocks are types which seen to be only variants from the rocks of this series, yet which are remarkable for the presence of actinolite.

One of these, from Section 2145, on the western side of the Murchison River, was examined microscopically, and proved to be an actinolite rock.

The actinolite showed tints varying from pale yellow to pale brown and pale green. Beyond the actinolite, which occurs in the form of allotriomorphic crystals or radiating bunches, there is only scattered iron ore and a sporadic prism or two of epidote.

The relation of such a rock to the more acidic members of the series is not clear, especially as no information was to be gained from the field occurrence. It may be that this type is merely a more basic segregation from the normal magma; but such a suggestion can be little more than a speculation in the present state of our knowledge of the district. The outcrop whence the described specimen was obtained was in proximity to the workings marked in the map. Hence it is possible that the actinolite is due to a local alteration of the quartz felsite by the agency of mineral-bearing solutions. And in this connection it may be mentioned here that coarse actinolite accompanies the occurrence of galena some distance to the south, on Section 2865.

The Fragmental Types.—On the extreme western flank of Mt. Farrell, at a point near the south-western corner of the northern section of the Mt. Farrell Company's leases, is a very remarkable rock, which appears to be an altered volcanic tuff. It is in immediate contact with the felspar porphyry which shows the vesicular cavities filled with chlorite calcite and chalcedony referred to above, but the actual junction could not be traced on account of the surface cover. The western continuation of this rock is entirely covered by the button-grass plain at the foot of the mount.

In appearance the rock is, on the whole, deep green in colour, but with grey and reddish blotches irregularly distributed. The varying splashes of colour are due to angular fragments, which are of different composition—some chalcedonic, others apparently fragments of the pink-coloured uncrushed porphyries.

At the junction of the Mackintosh and Murchison Rivers, still further to the west, a very similar rock is to be seen here and there; and the tramway cuttings afford sections which show that the fragmental varieties pass by quite insensible gradations into the massive porphyroid. We may look upon them as the fragmental porphyroids, or "clasto-porphyroids."

With microscopic aid it is still more apparent that these rocks are certainly fragmental, and yet possess many features in common with the other porphyroids.

The felspar crystals embedded in its mass are very considerably altered, with a great development of kaolin and epidote. In some the original crystal is replaced by an albite-epidote mosaic, with more or less silica and calcite in addition. The interstices between these altered crystals are filled with a mixture of chlorite, epidote, calcite, and kaolin.

In one slide there was visible an angular fragment of a glassy igneous rock. This piece seems to me to afford certain evidence of the shattering of an effusive rock by volcanic action. The glassy fragment is stained pale brownish by decomposition, but still shows a number of clear microlites possessing a straight extinction; and it possesses, in addition, a well-developed perlitic structure, which has been accentuated by the progress of weathering.

(2)—*The Granite Porphyry of White Hawk Creek.*

The sedimentary rocks of the White Hawk district—sandstone, limestone, and pebbly grit—have interbedded with them a dyke rock, which is a true "microgranite," or "granite porphyry."

It forms a broad dyke, which dips westward with the sedimentary rocks and outcrops on the eastern boundary of the leases.

The rock has a felsitic ground-mass, which is sometimes pink, sometimes green, and in which the porphyritic crystals of quartz felspar and biotite are set.

It is clear that considerable alteration has taken place since the rock first solidified—even to the naked eye. There is a considerable development of chlorite, by which in some cases the ground-mass, in others the felspars, are almost replaced by the secondary green mineral.

Where undecomposed the felspars are fairly large and pink.

Microscopically it is a typical microgranite, which is free from the effects of dynamic metamorphism, but altered by weathering. The ground-mass is a fine granular aggregate of quartz and orthoclase, in which are phenocrysts of quartz, biotite, orthoclase, and plagioclase.

The quartz has suffered considerable corrosion by the magma, and its borders are ragged, and sometimes deeply embayed. The felspars are also corroded, but not to the same degree as the quartz. The biotite shows usually its crystal outlines, and basal sections appear as cleanly cut hexagonal plates.

Decomposition has altered the biotite almost completely into chlorite—sometimes massive in form, at other times in tufted radiating aggregates.

The felspars are kaolinised or sericitized, and in some cases the decomposition has been attended by the introduction of iron and magnesium, and finely-divided chlorite penetrates the crystals. Epidote is present in small amount.

All through the ground-mass there is finely-divided chlorite, which imparts the prevalent green colour to the rock. The definite determination of the felspars is difficult, inasmuch as their alteration leaves little more than bare traces of original structure in most cases. They are quite commonly zoned, and both single and multiple twinning are still recognizable.

Whether this microgranite belongs in origin to the magma which has produced the plutonic mass of Granite Tor, or whether it is another variety of the series above described, cannot be determined from its mode of occurrence.

It lies in position between the two varieties of the igneous rocks, and nearer to the granite on the east.

The great distinction between members of the two groups is that the series already described all show more or less the effect of crustal movement.

Yet in the White Hawk area all of the rocks are noticeable for a freedom from the signs of mechanical deformation in a district of such considerable disturbance.

In age there is but little difference between the two groups of igneous rocks, so that the relative progress of decomposition is not of value as a criterion in distinguishing them.

The granite porphyry here described is quite uncrushed, the alterations that have been effected being simply the result of the work of surface agencies.

(3)—*The Granite of Granite Tor.*

On passing up the valley of the Mackintosh to the northward, an examination of the river gravels shows an ever-increasing proportion of pebbles of a holocrystalline rock quite different in type from the syenitic granite above described as occurring with the porphyries.

This other is a typical coarse-grained acidic granite in most specimens. Both muscovite and biotite micas are usually present, but some varieties show an almost complete absence of biotite and abundant silvery-white muscovite. The rock is coarser in grain than the syenitic granite of the Osborne Blocks, and often carries porphyritic crystals of orthoclase as much as an inch and a half in length.

This is the rock which occurs *in situ* at Granite Tor, and which has many features in common with all the other tin-bearing granites of Tasmania. Tin is reported to have been derived from this granite also.

Microscopically viewed, the rock is perfectly free from all signs of dynamic metamorphism.

The felspars, both orthoclase and plagioclase, are in a fair state of preservation, and only kaolin has resulted from their alteration. Their crystal outlines are well defined, and they have clearly preceded the quartz in crystallization. Muscovite and biotite are abundant, and the latter is sometimes chloritized.

This plutonic mass of granite appears to dip underneath the mica schists on its western border, and probably is connected in depth below the Mt. Farrell field with the other granitic outcrops of Mt. Heemskirk and the Meredith Range.

(4)—*The Diabase Pebbles.*

Among the pebbles which constitute the beds of the Murchison River and tributaries are some well-rounded ones of medium-grained diabase. This rock does not appear anywhere in the district *in situ*, and the pebbles must have travelled many miles from the eastward mountains by the agency of the surface-streams, and perhaps to some extent of glaciers. They are frequent in the pebble beds of the modern streams and in the older river deposits intersected by present streams or exposed by mining operations.

The diabase is known to occur *in situ* at Barn Bluff and at the Eldon Range, from both of which waters now flow westward by the valley of the Murchison; so these pebbles are probably derived thence, and have reached their present position by the transporting agency of the steep-graded streams.

B.—THE SEDIMENTARY ROCKS.

(1) *The Slate and Associated Crushed Grit and Conglomerate.*

These form the main sedimentary series of the central portion of the mining field; and although the lodes are not confined to the zones in which they are found, yet the productive lodes at the present time are situated in these old fragmental rocks.

There are all gradations—from the conglomerates, against which the harder and massive conglomerate of the central ridge of Mt. Farrell abuts, to the fine-grained slates further to the west. The grain is coarser on the eastern side of the belt than on the western.

The coarse varieties are easily recognised by their rounded pebbles of quartz, many of which have resisted the crushing forces. Some of the pebbles are drawn out into "eyes," and the whole rock structure is altered. The crushed grits of grain intermediate between that of the conglomerates and the true slates are at times very difficult to distinguish from the porphyroid, especially from the more markedly schistose varieties of the latter.

All varieties of this series show unmistakable signs of crushing, and the attendant reorganization of their contents, so that they cleave readily into flakes. The coarser kinds part in roughly parallel directions, while those of finer grain show a clean slaty cleavage for the most part.

At a few points in the neighbourhood of fracture-planes there has been an impregnation with silica, and the slates become hard, massive, and non-cleavable.

Where mining operations have penetrated these slates and exposed them it can be easily seen that there has been considerable alteration of both the structure and composition in the immediate vicinity of the lodes. The No. 4 tunnel of the North Mt. Farrell Mine has penetrated the altered zone, and runs far into the unaltered slate beyond. This latter at this place is a dark cleavable slate with fine-grained iron pyrites along the parting-planes. I could not perceive any visible graphite in the slate; yet where the lodes traverse the rock the appearance of graphite is noticeable, and the iron-bearing mineral is the carbonate, not the sulphide.

The structure of the slate near the lodes is also different. The even slaty cleavage is replaced by a remarkable contortion and brecciation of the whole rock. The cleavages appear to dip in any direction, and the lines of parting often appear intricately folded, fractured, and overthrust. These phenomena indicate that much of the stress which produced the fractures now filled with ore must have been of the nature of compression.

The majority of the rocks of this series are dark in colour, but there are some associated light-coloured rocks which, in my opinion, are to be classed with them.

To the west of the lode-bearing slates in the Mt. Farrell, North Mt. Farrell, and Mackintosh areas is a narrow strip of this pale clay schist or slate. The belt is distinguished from the ordinary slate in the geological map and section herewith.

At the North Mt. Farrell Mine there is a narrow belt of the dark slate still further to the westward; but in this case, as in all other visible sections along this belt, there appears to have been some degree of movement between the light and dark slates at their contact. The relation between the two is therefore not definitely certain on the evidence available. The persistence of the belt will be seen by reference to the map to be remarkable. I traced it northward as far as the Mackintosh River in Section 2909. Southward the rock is to be seen near the mouth of the main lower-level adit of the Mt. Farrell Mine, and extends till it is hidden by the button-grass plain.

An entirely similar rock is the country rock of the Tullibardine copper property, where it is obviously interlaminated with the dark slates on either side.

In the South Murchison section the eastern tunnel has been driven in a pale-coloured slate of a somewhat similar appearance. Here the pale slate is interlaminated with the darker, the junction being visible at the mouth of the adit. Between the ordinary dark slate and the paler variety there is no unconformity nor any plane of separation. The colour changes abruptly, and the slaty cleavage becomes less well marked.

The rock from the Mt. Farrell Mine was sectioned, and shows a number of small quartz granules strung out in wavy lines, and between them undulating bands of sericite and kaolin.

A specimen from the South Murchison section was also examined microscopically. It showed an even more homogenous texture. The sericitic bands are so fine as to be nothing more than strings. Calcite has made its way in along the planes marked by the strings of sericite, and forms eyes here and there.

With regard to the structural features of the members of this series, a very strong distinction should be made between the bedding-planes and cleavage-planes.

The two are being constantly confused on the field, and may lead to serious misunderstanding of the geological structure.

The slates especially are very seriously contorted at times, and the cleavage-planes are always the prominent feature, whereas the bedding-planes are not visible at all in the great majority of instances. In fact, it is an extremely difficult matter on this field to determine the dip of these sediments, when the beds are considered as a whole. The mining operations have given one or two exposures of the divisional lines between the members of the slate series and between the porphyroid and the slate, but in all such cases there has apparently been some degree of movement between the two rocks in contact, and the passage of meteoric water along these planes has masked the relationships of the rocks. In such cases were open to observation the dip of the rocks seemed be to the westward, and at an angle of from 60° to 70°.

At the South Murchison Mine the contact line between the pale and dark slate is nearly vertical, but inclines to the west.

The planes of schistosity dip almost always to the west, but there are great local contortions of these rocks, both near the lode fractures and in the unproductive zones; for instance, above the workings of the Farrell Blocks, on Section 2397, the planes of schistosity strike north-west

and south-east, whereas their normal strike throughout the field is parallel to the main axis of the Mt. Farrell ridge.

(2)—*The Massive Conglomerate of the Mt. Farrell Ridge.*

The core of the Mt. Farrell ridge is a rock which in its typical development is a coarse conglomerate, but with which are interbedded finer-grained sandstones, or even shales. These rocks are obviously all members of one great period of sedimentation, and must be treated of together.

The conglomerate is usually of a pinkish colour, and almost wholly quartzose in composition. The pebbles consist of all varieties of quartz—massive, banded, and chalcedonic—and of a quartz schist or quartzite schist. This latter schist is nearly all quartz, with very little pale-coloured mica, and the layers of mica are often contorted.

The cementing medium in the conglomerate is also siliceous, and usually very small in amount when compared with the large bulk of the rock that is composed of the pebbles. The sandstones also are almost wholly of silica, and are stained red by oxide of iron.

The strike of the beds is practically the strike of the mountain ridge, but it varies widely at one point near the fault-plane which traverses Section 2796.

The bedding-planes are not decipherable where the massive form is met with, and neither strike nor dip can be ascertained; but the coarser type passes over abruptly into the finer, and the structural relations become visible. There is a band of the finer-grained sandstone running the length of the mountain, from the south end to the fault-plane, almost on the very centre-line of the ridge; and on the eastern slopes, towards the valley of the Sophia River, the finer-grained sediments can be seen outcropping here and there through the button-grass.

The southern end of Mt. Farrell shows a great local thickening of the conglomerate, and a south-east spur of the mountain, which extends along the eastern bank of the Murchison River, is wholly of conglomerate and its associated sandstone.

The Murchison River breaks across the conglomerate at the southern end of the mount, and on the south side of the river the same beds are to be seen as on the northern; and "Little Farrell," as the portion south

of the Murchison River is called, has the same general aspect as the larger part on the other side of the river.

Viewed from the top of the southern end of the mount proper, the structure of Little Farrell is plainly visible. The same massive beds of coarse conglomerate are apparent, with the interbedded sandstone, but the finer-grained varieties of the eastern slopes of Mt. Farrell are not seen on the southern side of the river.

The structural features presented by the rocks of this series are of some interest, as they assist considerably in explaining the structure and geological history of the district.

The strike of the main series of beds varies from N. 5° W. at the south end of the mount to N. 10° W. above the Farrell Blocks trenches; and approaching the fault-plane, whose strike line has a bearing of 112°, the strike of the finer beds is continually making towards the westward, till it bears N. 45° W. Northward, beyond the fault-plane, the strike is N. 10° E.

At the southern end of the mount, where the spur runs out in a south-easterly direction, the strike-lines follow the spur round till their bearing is N. 30° W.

The dip of the beds which form the ridge of the mount, above the chief mining centre of the field, is practically 90°, and as the ridge passes southwards this vertical structure of the main beds is preserved.

The finer-grained beds on the eastern fall of the mount are mostly covered by button-grass, but appear to dip to the west.

Passing northwards, the main series of conglomerates acquire an inclination to the eastward as the fault on Section 2796 is approached, and on the south side of the fault dip east at 80°. Across the fracture-plane the structure is different. The more westerly members of the conglomerate series lie at an angle of 30° with the horizon, while the eastern beds, from the centre of the ridge eastwards, dip east at 70°.

The change of dip is abrupt, and I think it is due, not to a movement of the crust after the formation of the whole series, but to a tilting of the region during the process of sedimentation.

The main fault that intersects the series is a dip-fault, and its effect can be clearly seen from Innes' track along the foot of the mountain on the western side.

The weathering of the bent strata and the breaking-off of blocks of rock across the joints and bedding-planes makes the sediments, when viewed from the track, appear

to dip east on the west of the ridge at the south side of the fault gorge, and lower down on the same cliff faces to dip to the westward. However, the writer's observations showed that the dip was always to the east, or rather north-east.

The conglomerate series rests unconformably upon the complex of slates, porphyries, and porphyroids, with an unconformity between the two formations. The best position for observing this contact is from the south end of Mt. Farrell, and looking across the gorge of the Murchison River at the cliff section exposed on the southern side.

The vertical beds of coarse conglomerate on the western boundary of the series abut directly against the crushed conglomerate, which is the coarsest facies of the older crushed sediments. The divisional line is very sharply defined, and the older conglomerate has its planes of schistosity dipping away to the west at an angle of about 70°. The conglomerates are seen to continue right down into the bed of the river.

From the south side of this gorge, and looking northward, the beds appear vertical at the top, and yet as they approach the river seem to bend slightly and dip a little to the east. The inaccessibility of this portion of the mountain on the north side of the gorge prevented me from verifying this distant observation at closer quarters.

The conglomerate certainly comes right down to the river at this point, but the vast amount of boulders which have been broken away by the surface agents of decay and disintegration completely hide the actual contact of the conglomerate and the adjacent rocks at low levels. For the hard siliceous fragments broken away from the mountain crest do not easily disintegrate to form fine rock waste that can be borne away by the rivers, and accumulate at the foot of the gorge as a jumble of angular blocks of all shapes and sizes.

From the point where the river cuts through it, the conglomerate thins out on the south side, and disappears altogether not far to the east of the Tullah property.

At the northern extremity of the mount the same difficulty is experienced in finding the relations of the conglomerate to the rocks on which it rests, for the fragmental blocks conceal the junction.

The mountain seems to be split in two at its northern end by a strike fault. I could not find the actual fracture-line, for the cover of button-grass conceals everything. A

trench on the gap between the two bluffs of conglomerate shows the underlying rock to be of the slate series, and one or two outcrops of slate appear on the slopes of the gap leading down to the river at the extreme north end of the mountain. The western portion of the conglomerate here seems to have been separated from the eastern by a fault. If so, the fault has the effect of producing an increasing downthrow of the displaced portion as we go north. No trace of the split is to be found southwards, and the conglomerate is, on both sides of the gap at the north extremity of the mountain, of the most massive type, so that the bedding-planes cannot be distinguished.

The conglomerate bluffs weather to bold, bare, rounded knobs, and support no vegetation. The button-grass has crept up high on the slopes, and even covers part of the ridge, but on the whole the outcrop is bare and sharply defined.

Fragments of all sizes of the conglomerate occur along the valleys of the Mackintosh and Murchison Rivers. These are, for the most part, just blocks which have reached their present position by the relative lowering of the rest of the region by the action of the rivers.

However, I noticed some large boulders, notably some of several tons weight near the Farrell Siding, distributed here and there at all altitudes throughout the district.

In a region whose river systems have been continually undergoing modification, these blocks may have reached their present places by river action, but there remains the possibility of comparatively recent glaciation to account for the distribution of these as erratics.

This conglomerate is similar in character to that which forms a capping on so many of the West Coast mountains; and in all probability the beds at Mt. Farrell belong to the same period of sedimentation as the other entirely similar conglomerates. However, there are, of course, many breaks in the continuity of the series, yet none so great that they cannot be explained by the existence of either original breaks or gaps since formed by crustal deformation and surface degradation.

With regard to the origin of the conglomerate at Mt. Farrell, there are several points of interest to be considered.

It has been stated that the massive type consists almost absolutely of well-rounded pebbles of quartz, and that

these are considerable in bulk when compared with the interstitial sand and cement.

This uniformity in the composition of the pebbles, their general uniformity of size by the sorting-out of the finer material, the considerable regularity of the stratification along the original strike-line—all these argue for a local derivation by the action of the sea.

Contrast with them the pebble-beds forming at the present time in the channels of the Murchison and Mackintosh Rivers, and these features, especially the uniformity of size and composition of the pebbles, will be the more apparent.

The absence of pebbles of the porphyries and syenite seems remarkable, for the conglomerate admittedly overlies the complex of slates and porphyries uncomformably, so that these latter might well be expected to have contributed towards its bulk.

The quartzite and quartz schist pebbles seem to have undoubtedly been derived from the great masses of these rocks on the eastern side of the valley of the Sophia.

One is inclined to suppose that a tilting of the region took place at the time of the formation of the conglomerate which brought the sea-level to a line at the base of these quartzites, and below which the slates and porphyries were so far submerged as to be beyond the range of wave action. I am not aware of the nature of the rock formations which lie east of the quartzites, other than the mica schists (to be mentioned later) and the granite of Granite Tor.

Whatever be the mode of the origin of the conglomerate, there have been some changes since its formation. The tilting referred to above, and the fracturing of it, are subsequent; and in addition to these major movements, there has been a minute shattering of the whole series, and a later infiltration of silica. The whole of the formation is characterized by a complex of small intersecting veinlets of silica, which often cut through the pebbles and cementing matter as well, and the matrix seems to be rendered more dense by a siliceous impregnation.

With the silica is a certain amount of specular hematite. In spite of some rumours to the effect that galena was present, the only metallic mineral I found was this hematite.

At the level of the track passing through the gorge cut by the Murchison River, at the south end of the mount proper, there seems to be a tendency for the conglomerate to assume a schistose habit.

This is no doubt due to the stresses that have produced the tilting, and supports the idea that the beds have been bent upwards rather than that the whole series has been tilted as a block, and supports also the observations made from Little Farrell with regard to the structure of the series as a whole.

(3)—*The White Hawk Sandstones and Limestone.*

The White Hawk district, at the north-eastern extremity of the area examined, consists of a series of sedimentary rocks intruded by the granite porphyry dyke rock above described.

These sediments consist of three formations—a bed of limestone lying between a sandstone on the west, and a sandstone which has coarser pebble-beds interstratified with the finer material on the east.

The upper sandstone (western) of the series is fairly uniform and fine in grain. The dip is apparently in harmony with that of the other associated beds, viz., westward. The dip angle is 47° where it junctions with the limestone, but rises to 75° on the western boundary of the central White Hawk lease. The strike is about 10° east of north.

These beds proved fossiliferous at a point north-west of the original outcrop of ore discovered by Tom Farrell.

The fossils have been referred to Mr. Robert Etheridge (Jun.) for description, and the remarks of that gentleman on them are appended.

The limestone is a massive one of a dark bluish-grey colour, wherein part of the calcium carbonate has recrystallized. On weathering the surface of the rock becomes irregular from inequalities in the rate of solution, but the ridges found on a weathered surface show no signs of organic structure. The bed at its lower side where it rests upon the lower sandstone has a westward dip of about 40°.

There are very perfectly developed joint-planes, of which the best-marked series dip eastward at an angle of from 50° to 60°. The action of surface-waters in dissolving out portion of the carbonate along these joint-planes renders their presence very prominent near the surface, and the rock seems at first sight to be dipping eastward.

As is usual in limestone areas, there are many cavities of solution visible at the surface, which have been gradually enlarged until they form caves. Most of these lead down into the heart of the rock through the progress of rock-solution along bedding-planes.

Their influence on the mining has so far not been serious, for the work done has been at shallow depths. The White Hawk Creek, at the mine, is running on the limestone just at its junction with the lower sandstone, and the water cannot but be a great hindrance to future working at a greater depth.

The drainage from the hill to the west of the mine also can be seen to find its way in part by underground channels to a lower level.

The lower sandstone formation consists of a series of normal sands and a course pebbly grit. Portions of the formation, especially on its lower side, have been silicified into quartzites.

The thickness of the whole series is only from 130 to 150 feet, but as the slope of the eastern side of the creek gorge almost coincides with the dip of the rock the thickness appears to be much greater.

Fossils were obtained from this horizon also, and with the others from the upper sandstone were submitted to Mr. Etheridge, whose remarks are:—

"I have examined the specimens referred to in your letter, and although very poor impressions, I believe them to be as follows:—

"(*a*) Sandstone below White Hawk limestone contains impressions of one of the varieties of *Rhynchonella borealis*, Schlotheim, a well-known and widely-spread Silurian species.

"(*b*) Sandstone above White Hawk limestone contains many impressions of the brachiopod I have from time to time identified from Tasmanian strata as *Rhynchonella capax*, Conrad, and named var. *meridionalis*, and still believe to represent that species. In America it is one of the fossils characteristic of the Hudson River Group."

So the age of this sedimentary series is definitely fixed as Silurian.

There are two points of interest in the geology of this area when considered together with the rest of the district. It is noticeable that the coarser sediments—the pebbly grit referred to above—are on the extreme east of the series where the formations rest against the granite porphyry. This feature is in harmony with the relationship of the older crushed sediments—slate and crushed conglomerate—to the structure of the district.

Further, the still more noticeable feature of these rocks that distinguishes them from the other rocks of the district is the freedom from the signs of intense crushing.

While it is true that the small area here considered has not yielded to the intense crushing to the same degree as the rocks to the west and south-west, the series must have had a very great pressure to withstand; for to the west lie the slates and porphyroids, that bear witness to dynamical stresses in the immediate neighbourhood.

The whole block of country of which these strata form but a portion may have successfully withstood the crustal movement, and though the rocks have been tilted their particles may not have been forced over each other and drawn out in lenses. The nature of the rocks is such that the crushing stresses could have left but little traces; yet the block may have been part of the "foreland" against which the crushing of the other rocks has taken place.

But even so, the proximity of the highly altered rocks to the west makes one reflect further on the remarkable preservation of the original characters.

In my opinion the simplicity of the chemical composition of the sandstones and limestones has had a good deal to do with the absence of alteration.

Contrasting these rocks with the porphyroids we see a chemical composition of marked simplicity as against the equally marked complexity of the constitution of the igneous rocks.

Mention has already been made of the fact that all the members of the syenite-felspar porphyry series are probably very closely related in chemical composition, although their texture and mineral constitution varies continually. And these variations are beyond doubt due to varying physical conditions imposed upon the different facies at the time of their solidification. A variation of the physical conditions after consolidation, namely the subjection of the rocks to intense lateral pressure, has caused a secondary readjustment of the molecules, and the reorganised porphyries become porphyroids.

The several minerals of secondary origin, notably epidote, calcite, albite, and quartz, all take their origin by variations in the physical conditions to which the rocks are subjected.

But in the case of rocks that are almost wholly composed of calcium carbonate or of silica, no such molecular readjustment is possible. The originally finely divided calcium carbonate may crystallize and form a crystalline limestone, but no further change can result.

(4)—*The River Gravels.*

The only remaining sedimentary rocks of the district are the river-bed deposits, for the most part unconsolidated. The present rivers have cut their way down through an older alluvial accumulation that bears strong resemblance to that forming in the flatter reaches of the rivers now. The broad plain that lies at the foot of the western flank of Mt. Farrell is dissected here and there by streamlets that make towards the present-day rivers.

The deposits of this old flood-plain are a series of beds of gravel and sand, with the coarser beds at the bottom and the finer above them. The pebbles are of all sizes, and of very varying composition, although the quartose ones predominate. Many of these have undoubtedly been set free from the conglomerate of the ridge of the mount; and there are pebbles of the conglomerate itself containing several of the older pebbles and their cement all smoothed down together to form the single pebble of to-day.

These river alluvial deposits are restricted mainly to the broad plains through which the main rivers run, but I also came across a few small terraces on the White Hawk Creek which were formed of river gravel.

C.—THE METAMORPHIC ROCKS.

The alterations that have been effected by regional metamorphism in the rocks of both sedimentary and igneous origin have already been described in dealing with those groups.

There remain only some types whose unaltered state is now not so clear that we can trace the nature and degree of alteration from the original condition.

The Quartz Mica Schists.

These metamorphosed rocks form a fringe along the eastern boundary of the district, and are of chief interest in that they have contributed so largely to the formation of the massive conglomerate of the mountain.

Their relations to the slates are not to be seen on account of the broad flood-plain of the Sophia River and its dense cover of button-grass. However, there seems to be some definite continuity between them and the sedimentary series of the White Hawk district.

The writer was able to make no more than a cursory examination of this outer fringe, but it may be well to record the observations that were made.

Ascending the north-western spur of Mt. Swallow, which rises from the White Hawk Creek at the mine (see the sketched locality plan), the granite porphyry becomes a little finer in grain, and then a white quartzite is met with, which contains a little pale mica here and there.

The massive quartzites and the micaceous varieties or quartzitic schists seem to be inextricably intermixed, and their extent towards the east is considerable—about 2 miles. The only mineral contents of this belt with which I met were a small blow of hematite on the Mole Creek track, on the north-west side of Mt. Swallow, and a little disseminated arsenical pyrites further south.

Following the Mole Creek track eastwards the quartzite gives way on the eastern side to a broad belt of rock, which becomes more and more micaceous. Bands of the almost pure quartzite recur, but the rock here is normally a mica schist, which in some places becomes so fine in grain as to resemble a normal slate. These mica schists are quartz-biotote-muscovite aggregates, and show some local contortion of the bands. The planes of schistosity usually dip west.

This rock continues right up to the acid granite of Granite Tor, and seems to overlap the granite at the contact. Southwards from Mt. Swallow the Mole Creek track passes over the same quartzites and quartzite schists, and the bare bluffs on the eastern walls of the valley of the Sophia River are of the same material.

The granite porphyry is met with on the track a good deal further east than the White Hawk occurrence, and the quartz mica schists also seem further east. On the present visit I was unable to determine whether the strike takes a south-easterly bend on passing south, or whether the granite porphyry widens on its southward continuation, or whether a dip-fault has displaced the series.

The only other occurrence of similar rock types in the field is at a point between the White Hawk Mine and the Tullibardine.

A series of low, sharply defined ridges, running a little east of north, on the eastern side of the Mackintosh River, are formed of a dense quartzite, which carries a little pale green mica.

The western scarps of the ridges are very steep, and are covered with disintegrated blocks of this quartzite. This boundary suggests that there is a fault-plane striking north and south, but the button-grass completely covers all the surrounding country. To the east lies the upper sandstone of the White Hawk series, and to the west are

the slates of the Tullibardine area, but the junction-lines are invisible, and the presence or absence of any intervening strata undetermined.

(2)—The General Sequence of Events leading to the Present Geological Structure.

The following are the principal events which have succeeded each other in the area under consideration. They are presented in the order of their occurrence, as far as can be ascertained from the study of the rocks themselves and their field relationships.

1. *The First Period of Sedimentation.*—The series of sedimentary rocks, of which the slates of Mt. Farrell form the most considerable portion, appear to be the oldest rocks on the field. The passage from a conglomerate on the east through grits to the slates on the west seems to indicate a gradual submergence of an old basin. The old floor on which these sediments were laid down is not now recognisable; unless it be the quartzites and mica schists which outcrop on the eastern side of the valley of the Sophia River.

As regards the age of the slates, it can hardly be fixed as yet. Lithologically their resemblance to the Dundas slates is marked. These latter are fossiliferous, and of Ordovician age. But at Mt. Farrell no fossils have been recognised in this formation.

The slates may quite possibly have been contemporaneous with the sediments of the White Hawk area, now known from fossil evidence to be Silurian.

2. *The Intrusion of the Older Igneous Rocks.*—While it may be that these rocks are, in part at least, older than the slates, the writer considers the bulk of the evidence points to their later appearance.

The rocks which now appear as diverse types seem to me to belong to one great series, and to have resulted from one magma. The syenites, quartz porphyries, felspar porphyries, and their schistose derivatives show a remarkable difference between the south-eastern and the western portions of the district. In the former there are the holocrystalline types, between the two are the evidences of intrusion into the slate series, and on the west are the volcanic members. The suggestion at once presents itself that we may have here the various phases of a great intrusion of igneous material, of which the portion which remained far below the surface solidified and formed the

holocrystalline syenites. Portion may have spread laterally in the form of sills through the slates, and another portion again may have reached the surface to form lava-flows and volcanic tuffs.

It is certainly possible that the intercalated sheets of porphyroid were contemporaneous lava flows; but some of them are certainly intrusive, and some also are effusive.

At least two horizons of the fragmental type of porphyroid were detected—one near the main road of the Tullah township, and one at the junction of the Mackintosh and Murchison Rivers. The great thickness of the porphyroid to the west of the slate appears to be due to a great succession of lava flows.

The relations of these igneous rocks to the slates will always be somewhat obscure, on account of the subsequent alteration. There are very few visible outcrops of the junction lines, and the distinction between the two groups is sometimes very difficult in the field.

If this hypothesis be correct—and there are no discrepancies between the evidence afforded by either the igneous rocks or the associated sediments—the eastern portion of the field, now at the level of the surface, must have been deeply buried. The coarser sediments of the slate series would thus be the lowest beds of that series, and the syenites typical plutonic rocks.

3. *The Inversion of these Rocks before the Formation of the later Conglomerate.*—The newer conglomerate and its associated finer-grained sediments show a marked structural contrast to the older sediments on which they lie unconformably. The eastern beds in the newer conglomerate are the finer, and the western beds are coarser. And the appearance presented by the conglomerate as a whole gives the impression that the western beds were the first formed of that series. This being so, the whole of the pre-existing formations must have been completely inverted by folding. If the igneous rocks are, as considered by the writer, older than the conglomerate, they must have shared in the folding.

In this tremendous crumpling of the crust a very considerable degree of schistosity must have been developed in the folded rocks, and at a date prior to the formation of the newer conglomerate.

This folding may have produced the fractures which have later served as circulation channels for the metalliferous solutions.

4. *The Formation of the Newer Conglomerate.*—Following upon the lastmentioned folding of the region came the submergence of the area and the formation of the conglomerate (and the sandstones of the same series).

The submergence may have been such that most, if not all, the igneous rocks were below the reach of wave action, and if so the absence of pebbles of these rocks would be accounted for.

The age of this rock formation is considered by Mr. G. A. Waller to be Upper Silurian.* He refers the red conglomerates of the West Coast to the base of the Upper Silurian, since the fossiliferous strata of the Upper Silurian period rest conformably on them at Zeehan.† Also on Mt. Jukes the sandstones interbedded with the conglomerate contain Upper Silurian fossil remains.‡

There are sediments of Upper Silurian age in the White Hawk area of the Mt. Farrell district; but their relation to the massive conglomerate of the mountain is not yet known.

During the formation of the conglomerate and its accompanying sandstones there was at least one further tilting of the region. For the eastern beds at the northern end of the mount are not conformable with the western. The eastern beds dip towards the western, but there is no folding. I believe the change of dip is purely an unconformity, not a synclinal fold. At all events, I could not see any repetition of the coarser beds, as might have been expected if a fold were present.

South of the fault which traverses Section 2796 the dip of the eastern beds is less easily recognised, on account of the cover of button-grass on the east side of the ridge.

5. *The Folding of the Region in Late Silurian or Devonian Time.*—After the formation of the sediments of Upper Silurian age, the region suffered yet another lateral thrust. Under the stress the crust was again buckled, and the tendency of the movement was to restore the older sediments (of the slate series) to their former position.

The conglomerate of Upper Silurian age was by this movement tilted almost upon edge, for the greater part of its extent at Mt. Farrell.

A great fracture occurred during or after this folding, and is marked by the fault plane near the northern extrem-

* G. A. Waller: "Report on the Mt. Farrell Mining District," 1904, pp. 2 to 6.

† *Ibid.*, p. 4. ‡ *Ibid.*, p. 6.

ity of the mount. And the rocks south of the fracture plane have been pushed to a higher angle than those to the north of it.

This crustal movement would undoubtedly cause the development of a schistose structure throughout the region, and all rocks of greater age than this period would be affected by it. The conglomerate appears but little affected. The slates and igneous rocks, which may have already, as explained above, been rendered schistose, would have their schistose character still further intensified. The direction of the strike of the planes of schistosity in general conforms to the axial strike of the mountain, although local variations do occur.

At this period, if not at a still earlier date, the shales became slates. The pebbles of the older conglomerate were drawn out, and a schistose mantle formed round the felsitic rocks. The holocrystalline rocks, too, were crushed, but the signs are less apparent.

Accompanying the minute crushing there may have been developed at this period some at least of the fractures, which later became impregnated with metallic ores. The siliceous rocks of the mountain, the conglomerate and sandstone, are fractured in all directions, and are recemented by a later infiltration of silica.

The sedimentary rocks of the White Hawk area are tilted, but otherwise unaffected, except perhaps by the development of a few fractures, the position of which is very hard to determine.

6. *The Intrusion of the Devonian Granite of Granite Tor.*—The plutonic mass of granite at Granite Tor intruded at a date later than the crushing of the older rocks of the district. It is a granite which is distinctly more acidic in composition than the members of the older igneous series. But still more marked than the difference of composition is the freedom from signs of crushing in this more acid granite.

I was not able on this visit to examine in detail the relation of this granite to the remainder of the rocks of Mt. Farrell and the neighbouring districts. However, in my opinion, it is more than probable that the outcrop at Granite Tor is merely one point where the agents of denudation have laid bare portion of a huge granitic mass which possesses in depth unbroken continuity.

We do know of the outcrop of an entirely similar granite at several other points, namely at Cox's Bight, Heemskirk, the Meredith Range, Hampshire Hills, and the Dove

River. Moreover, at the Renison Bell Mine, near Rosebery—a locality intermediate between the points where the granite outcrops—there are tourmaline-bearing quartz porphyry dykes. In the same neighbourhood, at the Colebrook Mine, there occur the borosilicate minerals axinite, datolite, and danburite. These occurrences both point to the existence of the granitic mass below the surface. For the tourmaline quartz porphyry dykes are the apophyses of such a mass, and the borosilicates are beyond doubt the result of the reaction on the country rock of the boric emanations given off from a cooling granitic magma.

From this it appears that the Mt. Farrell district is underlaid in depth by the granite which appears to the east at Granite Tor and to the west at the Meredith Range and Heemskirk. And the existence of the mica schists lapping over the granite on the sides of Granite Tor supports this view. For these mica schists appear to be sediments of varying grain altered by contact metamorphism, and the granite dips under them where I investigated the junction of the two rocks on the western flanks of Granite Tor.

The period of the intrusion of this deep-seated mass of granite, which has certainly liberated the mineralizers and given rise to the ore deposits at the localities abovenamed, must have been later than the Upper Silurian and previous to the Permo-Carboniferous.

In deciding this matter of age, it is necessary to regard the various outcrops of this uncrushed granite as outcrops of a single geological unit. For my part, I consider that we are justified in doing so. The evidence regarding the age is conclusive, and may be briefly cited under three heads*:

(1) The rocks of greater age than the Upper Silurian are folded and rendered schistose by the disturbance of the region. The granite in question is free from such foliation.

(2) The granite is known to be intrusive into the ultrabasic igneous rocks of the gabbro, pyroxenite, and serpentine types at Trial Harbour. These ultrabasic rocks are intrusive into the Upper Silurian strata at Heazlewood and Zeehan. The granite and gabbro may possibly be two extremes of differentiation of one original magma; and the granitic veins in the

* See G. A. Waller: "Report on the Zeehan Silver-Lead Mining Field, 1904," p.p. 11 and 12.

serpentine may be the result of final stages in the consolidation of the one main mass. However, even if this is so, the gabbro-granite magma has intruded into strata known from fossil evidence to be of Upper Silurian age. Also, the granite intrudes into the peculiar sandstone, which has been called the "pipe-stem" or "fucoid" sandstone, at the Dove River, and the River Forth, in the Middlesex district.

(3) On the other hand, the granite is not intrusive into the Permo-Carboniferous strata, but exists in the form of rounded pebbles as a constituent of the conglomerates of that system; and at Ben Lomond the Permo-Carboniferous strata have been observed to rest upon the denuded surface of the granite.

7. *The Period of the Deposition of the Ores.*—After the main period of crushing of the country rocks of the field came the filling of the fissures, which were either already prepared for the impregnation by the previous crushing, or were superinduced upon the crushed rocks by later stresses. We know that this filling of the fissures was of later date than the crushing, as we find fragments of the crushed rocks cemented into the uncrushed lode matter. Yet by this statement it is not intended to convey the impression that all movement had ceased at the time of the filling of the fissures. For it will be seen later that the lodes themselves show signs of movements which have brecciated their metallic contents.

The filling of the fissures must have taken place at more than one period, for there seem to be two distinct types of vein-stuff.

The first impregnation appears to have been a siliceous one, and to have produced quartz-veins free from metallic minerals other than iron pyrites.

Later, there must have been still further strains developed in the rocks of the district, and a fresh set of fractures resulted. Some of these cut across the original quartz-filled fissures, as may be seen in the section exposed by the open-cut of the North Mt. Farrell Mine. It is to this later filling, with its prevalent gangue of iron carbonate, that the productive lodes are due.

The age of the fissure-filling I believe to be that of the intrusion of the Devonian granite; and I believe the introduction of the metallic ores to be due to the intrusion of that mass. It is now a firmly established fact that the

later stages of the consolidation of a deep-seated mass of granitic composition are accompanied by the emission of highly heated vapours, which, under such conditions of high temperature and pressure, have the power of holding in solution metallic compounds.

On their expulsion from the igneous rock, and during their ascent into the upper regions of the earth's crust, they experience a fall of temperature and pressure which eventually suffice to cause precipitation of the metallic contents in the channels which are serving at the time to carry the vapours or solutions upwards.

It is, I believe, to the Devonian granite that we must look for the immediate source of the metallic compounds of the Mt. Farrell district; and the age of the impregnation is therefore that of the final stages of the granitic intrusion.

8. *The Events subsequent to the Formation of the Lodes.*—The events of later date than the vein-filling, which have modified the geology of the district, are two in number:—

(1) Further movements have taken place between the already fractured segments of the crust. These readjustments have modified the structure of the lodes themselves, since the former fissures have remained planes of weakness, and the strains have been relieved by their reopening and the differential movements of the walls.

(2) Surface agencies have operated on the region, and carried away much material, and deposited the river alluvials. These agencies have not been uninterrupted by movements of deep-seated origin, for we find the older river flats cut into by the warping of the region since their formation, with the consequent revival of the corrosive power of the streams.

V.—ECONOMIC GEOLOGY.

(1)—The Relation of the Ore-bodies to the Several Rock Types.

When any one single mining property on the Mt. Farrell field is considered apart from the surrounding leases it may appear that the ore-bodies are restricted to a certain lithological group.

In other words, the nature of the country rock may appear to have influenced the lode in the several particu-

lars of width, mineral composition, richness, or even position.

It is a matter of most vital importance to the field that this matter should be carefully considered.

The guidance of the present development work on the mines is not the only point at issue. The whole feature of the district, and the further prospecting for the yet undiscovered lodes, are concerned with the correct interpretation of the geology of the known parts of the field.

And in the examination of these known facts it is absolutely necessary to regard the field as a whole. The several properties are dealt with separately in a later part of this report, and their particular features noted. At present the matter of the lode phenomena exhibited by the field as a whole will be discussed, and the changes in the composition and structure of any one single lode at different points along its course taken into consideration; for the boundaries marking-out the mining sections are artificial, and have no place in the general discussion of natural phenomena.

This matter may seem perfectly obvious, and not worthy of mention; yet it is owing to an exaggeration of the value of local phenomena, and the attempt to make these of general application, that no little energy and capital have been fruitlessly expended on the Mt. Farrell field.

It is an old-established view held by many mining men that the metallic contents of ore deposits have a genetic relationship to the country rocks with which they are associated.

The practical aspect of this statement means that if the country rock, which is usually of great extent as compared with the lodes enclosed in it, and easily found, be sufficiently diligently searched, the possibilities of the discovery of lodes are great; and, moreover, it is held that in some classes of country rock lodes of one composition will be found, and in other rocks there will be lodes of different composition.

It does not seem possible to separate this view from the idea, even if no actual expression is given to it in so many words, that the country rock is responsible for the formation of the lodes; that is to say, that by the action of some process or processes the country rock has actually provided the metallic contents of the lode. The ore-bodies are thus thought to be merely the metallic contents of their country rocks gathered together in a concentrated form.

And there are many occurrences of the metallic ores that lend colour to this view, and which will lead the

prospector astray unless he is careful to distinguish between the great classes of the country rocks enclosing within their boundaries the metallic minerals sought by the miner, viz.:—

(*a*) The country rock which is part and parcel of the same rock-mass from which the ores also have been derived, *i.e.*, which has certain definite genetic relationships with the ores.

(*b*) The country rock which has had fissures formed in it by the action of internal or external causes, or which has from the time of its formation held certain cavities which may act in the same way as superimposed fissures.

These cavities, in this class of associated country rocks, supply only the empty place for the lode-filling, which is introduced from without in solution. These solutions are now generally admitted to be ascending hot solutions similar to those which appear at the surface in volcanic regions, or which have been tapped by mining operations.

That they derive their aqueous content, their heat, and the metallic salts in solution from some deeply seated igneous rock is now also admitted by most mining geologists.

The deposition of the metallic ores in the cavities through which these solutions circulate on their ascent, is due to definite physical and chemical laws; the chief causes of precipitation being the decrease of the temperature of the solutions in their ascent, and the lessening of the pressure to which they are subjected.

(*c*) The country rock which has has held disseminated through its mass a certain small proportion of some metallic compound, and from which meteoric waters have leached out the metallic content, once widely disseminated, and have redeposited it in more concentrated form in the larger cavities or fissures.

When once the prospector has realised that these several classes exist, he must learn to interpret the phenomena of the field with which he is concerned, and to decide the class to which the ore deposits of the district belong; for the genesis of the lodes is the most important point to be decided when future operations are being planned.

Applying the above generalities to the case of the Mt. Farrell lodes and their surroundings: The relationship cannot be that of the first class above mentioned, in that we find lodes, whose general similarity will be indicated later, occur in rocks of widely different origin, viz.. the slates which are undoubted sediments, and the porphyries or their derived schistose types which are certainly of igneous origin.

Although the occurrences of tin and some other ores, and perhaps even some silver-lead ores, are of this character, the lodes of Mt. Farrell cannot possibly be considered to bear this relationship to the rocks within which they are contained.

It remains then to decide between the other two types. The criteria by which we are able to judge whether the lode-material was introduced from without, or whether it was gathered together from within the enclosing rock-mass, are several.

Of greatest importance for this purpose are a series of exact analyses to determine the amount and distribution of the metals in the country-rock, and the state in which they exist there; that is to say, whether the metal is present uncombined, or in combination with sulphur, or as a constituent of the rock-forming silicates. This work has not been attempted with regard to the field in question; but extremely valuable and laborious chemical work has been performed on other mining fields, from which general conclusions have been drawn.

The great majority of metalliferous lodes may, by the application of these methods, be shown to owe their metallic content to the introduction of the material from sources outside of the immediately enclosing rocks. This is a general statement that is applicable to most ore veins, and the so-called "lateral secretion" theory cannot be made applicable to more than very few mineral occurrences.

In the disproving of the views of the believers in lateral secretion, the most elaborate work that has been done was performed at Freiberg, whose lodes offer several points of similarity in composition to those of Mt. Farrell.

In making the above general statements it is assumed that the lodes of Mt. Farrell do not differ as regards origin from those of other similar mining fields.

There are certain other features presented by the lodes and the country rocks which point to their mutual independence.

Lodes of the same character, possibly even different portions of the same lode, are found to occur in both the massive felspar porphyry and the schistose porphyroid on the south side of the Murchison River. Whether the lode that is now being prospected by the Thomas' Blocks Company extends northward into the slate belt is not determined so far. If it does, the example taken becomes still more instructive, and proves, for that part of the district at least, that lodes are not restricted to the igneous rock and its derived schist.

We know, for the more northerly part of the field, that the productive lode of the Murchison River Mine is in the porphyroid, and those of the North Mt. Farrell mines are in the slate.

It is true that in the case of the Murchison River Mine the presence of the porphyroid seems to be necessary for the existence of the lode. This is one of the cases which calls for further investigation.

In a later portion of this report it will be seen that the Murchison River lode is one the strike of which varies considerably from that of the other lodes of the field, and the course of which cuts obliquely across a narrow belt of porphyroid enclosed within the slate. The productive zone in the lode is restricted, as far as has yet been determined by mining operations, to the zone which is enclosed between walls of porphyroid. The lode-fissure extends beyond the porphyroid band on both the northern and southern side; but it has obviously pinched at each end, and the small amount of prospecting work done in these two directions has not yet disclosed an ore body of sufficient size to be payable.

Yet the lode-channel is continuous, and galena is visible on its track, as well as the siderite which so commonly accompanies the lead ore on this field.

With regard to these phenomena, the writer is strongly of the opinion that the existence of the broad ore-shoot in the porphyroid and the relatively narrow track of the ore in the slate is due, not to the difference in composition between the two rocks, but to the difference in the behaviour of these rocks when they were subjected to the strains which resulted in the fissure now traceable by its ore-filling and the development of characteristic minerals along its course.

There are no two rock-masses of the earth's crust which can be expected to behave in exactly the same way under strains sufficient to produce deformation; and in this case the physical dissimilarity between the two rocks

is considerable. The porphyroid at this spot is a very massive type, with few of the markedly schistose characters. It appears to have broken, under the deforming stresses, along a plane, in the same way as a brittle object might break if submitted to such treatment.

But in the case of the slate, the trace of fracture, though quite distinct, is not clean cut as in the porphyroid; it is rather a fracture zone. Moreover, the two walls of the fracture appear to be different in the two rocks where the lode is in porphyroid; the alteration of the country rock and its impregnation with the lode-matter is slight and the wall is clean. On the other hand, the slate carries the lode-material disseminated through it beyond the actual fracture.

All this evidence points to the fracture having been one of actual displacement when it was formed in the porphyroid, and to its having been a "distributive" break in the slate; that is to say, although the total result may have been the same, the single fracture has its place taken by an elaborate system of minute dislocations. This fracturing was of prior date to the utilization of the cavities by the metalliferous solutions.

The nature of the fractures has undoubtedly had a great influence in governing the distribution of the circulating metal-bearing solutions; but beyond this the influence of the country has not been effective in the control of ore-deposition.

Another case that calls for investigation, as it seems to have given rise to a belief that change of country has been accompanied by change of the lode-filling, is that of the copper lode exposed by trenches on the northern section of the Mackintosh leases.

This occurrence of copper is situated in the narrow belt of pale-coloured clay schist very close to the slate boundary. Now, in the same mining section in the south-west corner the slate contains the galena lodes which have been worked, off and on, by tribute parties; and in this case the pale clay schist lies a little to the west of the lodes, so that the impression is given that the lead lodes are present in the slate and the copper in the clay schist.

I regret that no work has been done to try and expose the geological structure between the two occurrences mentioned. Still I am of the firm belief that they are both on one and the same lode-fissure, and that this lode-channel traverses at a very small angle the junction-line between the clay schist and the slate.

The occurrences spoken of are directly in the line of several other outcrops, and it seems to me more than probable that the series are on a continuous fracture system.

As regards the change of composition of the lode-filling with the change of country, the alteration is neither so abrupt nor so considerable as is generally thought.

All through the field there is present, in constant association with the galena, a certain amount of copper pyrites. In all the mines it is noticeable, and at times is found in considerable bunches, even in a mine so free from other metallic minerals than galena as the North Mt. Farrell.

The same variation in the lode-filling is noticeable with respect to other minerals, namely, in the distribution of zinc-blende and the antimonial ores.

The inference to be drawn from these local concentrations of one or other of the metallic minerals is that from point to point along one lode-channel or along the general line of fissuring in the district there have been variations in the relative proportions of the different metallic elements present in the solutions which have brought the ores into the fissures; and these variations have occurred during the primary filling of the fissures, and are not secondary phenomena caused by the leaching-out from the lodes of one or more other mineral constituents, for the variations are noticeable where the lodes are perfectly free from all signs of weathering, leaching, or secondary deposition.

The common feature shared by both the copper and lead deposits on the Mackintosh northern section is the development of siderite as a gangue mineral. This fact affords additional evidence that the mineral-bearing solutions in each case have been of the same character, although the proportion of the metals present has varied.

And still more conclusive is the fact that in the southwest corner of the Farrell Blocks section, north and adjoining the Mackintosh property, there is a lode-formation which I take to be the continuation of this same series, and in which both galena and copper pyrites occur. Here the lead content seems to be once more asserting itself, and is noticeable further north on the Farrell Blocks property, and in the section, No. 2909, further north.

Again, it should be pointed out here that in the case of the prospecting work that has been done on the Tullibardine property a few miles further north, the same alternations of lead and copper ores are to be found; and

some parts of this area show both lead and copper occurring together.

Where the two metals seem most cleanly separated from each other on the Tullibardine lease, the country rock is the same—the pale clay schist.

With this evidence of actual facts of occurrence before us, the control of the country rock on the lode-filling can be hardly appreciable, as regards primary ore-deposition; and the Mt. Farrell district does not show any feature which is not open to question in favour of the interrelation of the lodes and the walls enclosing them.

Before leaving this subject there remains the question as to whether the silver content of the galena in the White Hawk Mine is affected by the fact that the lode is in limestone country. I have heard it stated on the field that a high, or even average, silver content could hardly be expected on account of the presence of limestone, and parts of the Zeehan field were mentioned as affording similar instances.

This has been recorded by Mr. Waller, in his report on the Zeehan field (page 17).

It is a question which requires a good deal of detailed investigation before any explanation can be given of the phenomena. As regards the White Hawk property, the ore from which low silver returns were obtained is thoroughly oxidised, and the progress of weathering may alone account for a relative impoverishment in silver.

There is no doubt but that the silver content of the ore would be removed more rapidly than the lead by oxidation and leaching; and I have seen assays of the White Hawk galena which are of normal tenor. Whether these show the average value of the ore remains to be seen. At least some of the ore is not below the average of the field, and it may prove that the low values obtained from the gossans are due to weathering; and in limestone country it is well known that oxidation proceeds to a very much greater depth than in other rocks less permeable to meteoric water.

(2)—The Ore Bodies of Mt. Farrell.

It is found that metallic ores are almost invariably discovered grouped together in certain definite associations with each other, and with certain characteristic gangue minerals. These constant associations give a few well-defined paragenetic groups or lode types. And the lodes of Mt. Farrell, while differing among themselves, conform strikingly to some of the well-known lode types.

A.—LEAD ORES.

The Spathic Lead Ores.

Beck defines this type in the following words*:—

"In this class the gangue consists essentially of the carbonates, calcspar, brownspar, rhodochrosite, siderite, and quartz. The ore minerals are argentiferous galena, argentiferous sphalerite, and less often, pyrite, marcasite, tetrahedrite, both with and without silver, together with high-grade silver ores, especially ruby silver and argentite.

"The structure is usually imperfect, and but seldom well branded. The ore minerals frequently occur sprinkled through the gangue."

It is to this type that the main producing lodes of the district belong. The lodes that have been worked on the Mackintosh property, the North Mt. Farrell and the Mt. Farrell leases, all conform closely to the type.

The only feature in which these lodes differ at all from the description of the general type is this—that there is uniformly present in the lead ores a certain amount of copper pyrites, and more of the copper than the iron pyrites.

This copper pyrites is sometimes very prominent in bunches, but usually occurs as small irregular blebs scattered through the lode.

On the south side of the Murchison River the same general lode type is the characteristic one, and the ore of Thomas' Blocks shows the features best.

The Tullah Mine exhibits a difference of lode-structure that may seem to mask its mineral composition, but the same lode type is undoubtedly represented.

To the north of the main productive area, the type again recurs where the lead is found on the Tullibardine property.

With regard to the gangue minerals that are associated with the galena the carbonates are practically always strongly predominant. (Reference is being made here to the lead lodes, not to the barren siliceous quartz reefs.)

There is usually a little silica either restricted to a certain zone or in irregular veinlets and bunches in the gangue.

The carbonate mineral is usually siderite, but minor amounts of calcite, dolomite, and intermediate varieties like ankerite also occur.

* Weed's translation: "The Nature of Ore Deposits," Vol. I., p. 243.

These carbonates containing less iron are noticeably present where the enclosing walls are freer from iron, as where the lodes traverse the pale clay schist or the porphyroid.

The proportion of lead to zinc sulphide varies very much in even the same mine; yet zinc-blende is not such an important mineral as in the sulphidic ore of the Murchison River Mine.

Of the antimonial ores there seems to be a very irregular distribution. They occur rather in pockets and bunches in a lode, the general character of which is quite normal. These bunches usually afford high returns on account of the fahl-ore, which carries silver, as a rule. The occurrence of this class of ore seems most common in the Central Farrell and the Murchison Extended (lately North Murchison) leases, Sections 1980 and 1075.

I have been informed that ruby silver ore has been seen at various times in small amount on several of the mines but did not meet with any specimens during my examination of the field.

At Thomas' Blocks there occurs, in addition to the carbonates, a small amount of white and purplish fluorite on the walls of the lode.

The Pyritic Lead Deposits.

Beck's description of the type is this*:—

"In the pyritic lead veins, quartz, galena, sphalerite, pyrite, arsenopyrite, and chalcopyrite are most abundant. As accessory constituents of the gangue we have hornstone, jasper, ferruginous quartz, calcspar, siderite; more rarely, brownspar and chlorite . . . The vein-filling has a prevailingly massive structure, in which the vein minerals occur, either commingled or in separate compact masses. More rarely the ingredients are arranged in bands."

To this description the ore of the Murchison River Mine answers almost in every particular. In addition to the sulphides mentioned, pyrrhotite is common. The blende seems the most abundant of the sulphides, but the others all appear predominant in various parts of the lode.

Among the gangue minerals there is usually a little siderite near the walls, but it is inconsiderable; and in one spot in the centre of the formation there was a small

* Weed's translation: "The Nature of Ore Deposits," Vol. I., pp. 235 and 236.

clean pocket of barytes. The ore also carries gold in small amount.

Other Occurrences of Lead Ores.

Here and there, on the south-eastern portion of the field are occurrences of galena associated with chalcopyrite, and no traces of walls are visible. The country rock is chloritized quartz keratophyre or quartz felsite, and the ore occurs as scattered blebs in the rock.

These deposits, as far as can at present be determined, do not seem likely to produce much ore.

Yet another type of occurrence is to be seen on the slopes of Mt. Murchison, on Section No. 2865, where the galena is associated with barytes and actinolite, together with calcite and quartz.

This may possibly correspond to the type of veins called by Beck the 'barytic lead veins."*

"In this class of veins," according to Beck, "the gangue consists of predominant barite, with fluorspar and quartz or jasper, besides calcspar. These minerals are generally intergrown in a remarkably thin-banded structure. The barite especially occurs in finely-crystalline crusts (calc-barite); the fluorspar in diverse tints, but mainly green and yellow. The ore minerals, which either form thin crusts or appear sprinkled through the gangue, consist of argentiferous galena, often developed in large flakes, pyrite and marcasite; also zinc-blende, copper pyrite, gray copper, and at times rich silver ores."

In the occurrence on Section 2865 no sign of fluorite was seen. However, it may have been present, as there was only a very small excavation to examine at the time of my visit.

The gangue is a mixture of quartz and barite, and iron pyrites is associated with the galena. Coarse columnar actinolite is associated with the gangue on the borders of the metalliferous area; but there is far too little done on the work to determine anything more than the presence of the minerals mentioned.

The other occurrence of lead ore is that between Kitson's workings and this last-described deposit. The galena occurs as fine dust-like particles in a very pure barytes. There is no sign of an economically valuable lead deposit here. The barite is treated of in a later portion of this report.

* Weed's translation: "The Nature of Ore Deposits," Vol. I., p. 258.

B.—COPPER ORES.

The Cupriferous Veins.

The most considerable amount of copper present on the Mt. Farrell field is found in veins of a rather strange type, to which some reference has been already made.

In the opinion of the writer, they are closely connected genetically with the spathic lead ores, and are due to variations in the composition of the ore-bearing solutions at different points along the fracture system.

Both quartzose and spathic copper ores are well-known types found in many parts of the world. The occurrences at Mt. Farrell resemble to some extent the spathic ores described by Beck in these terms*:—

"The gangue of these veins includes some quartz, but often consists chiefly, and sometimes entirely, of various carbonates, particularly ironspar, as well as calcspar and dolomite.

"Barite is very common, and is at times accompanied by fluorspar. The ore minerals are chalcopyrite, bornite, glance, tetrahedrite, and pyrite. Cobalt and nickel ores and various other ores also occur as accessory minerals."

This description applies to parts of the cupriferous bodies at Mt. Farrell; but the usual gangue is almost wholly quartz with small stringers of carbonate, and the primary ore is almost always, if not always, chalcopyrite.

If the views stated above are correct, viz., that these copper occurrences are local variations from a somewhat similar lead type, the gangue is apt to become very much more siliceous where the copper is present.

Both the Mackintosh and the Tullibardine ores are strikingly similar, and are of this character: In immediate proximity to each, galena is to be seen, both alone and in association with the copper pyrites.

Unfortunately, both properties are but little developed, and future operations will afford much more information on this subject.

The Disseminated Ore of the South-eastern Sections.

The Osborne Blocks and the more southerly sections show several minor occurrences of ore which do not appear to be fillings of the usual types of fissures. They seem rather to be lenses of ore disseminated through the somewhat altered country rock.

* Weed's translation: "The Nature of Ore Deposits," Vol. I., p. 226.

One such occurrence on the Osborne Blocks is in immediate proximity to a large blow of hematite; but whether the two have one origin it is impossible to say.

In these cases the copper ore is almost always chalcopyrite. Some bornite is present at times, and fine specks and facings of galena are usually associated with the copper. These remarks apply to the occurrences of the Osborne Blocks, and to some extent to the small pocket of chalcopyrite visible on the slope of Little Farrell on C. Thomas' section. In the latter case there is quartz showing more prominently than in the other cases.

On the northern slopes of Mt. Murchison there is another of these hematite blows which shows stains of copper sulphate where it has been cut by a short tunnel, and the neighbouring porphyroid is flecked with green spots of malachite.

C.—ORE DEPOSITS OTHER THAN THOSE OF LEAD AND COPPER.

Between Kittson's workings, in the section now charted in the name of L. Jolly, and the two 40-acre sections, there is a very well defined reef of almost pure barite, which seems to occupy a fissure of considerable length.

Its possible value as a source of salts of barium is dealt with later.

At Kittson's workings, Section 2829, there are several small veins running in all directions, which contain a mixture of iron and copper pyrites, with some specular iron ore. In addition, at one spot there is a fair quantity of native bismuth and a small amount of a steel-grey sulphide of copper, lead, bismuth, and antimony—probably lillianite.

Some rich silver ore is stated to have come from this spot. The mineral containing it could not be detected in the workings at the time of my visit.

In mentioning other ores it is well to remember that tin ore has been recovered from the granite of Granite Tor not far from the White Hawk Mine.

D.—THE QUARTZ REEFS.

There are some well-defined barren quartz reefs at Mt. Farrell which have caused much waste of time, energy, and capital on the part of prospectors.

By very many on the field they are still regarded as possible sources of lead ore, and this idea is well shown in

the term "main lode" applied to one of these reefs on the Mt. Farrell Mine.

A matter of great importance to the central productive portion of the Mt. Farrell field is the correct interpretation of these quartz reefs.

Their definition is usually excellent, as they occur for the most part in the slate, which readily weathers away from the reef or carries numerous "floaters" of quartz to mark their presence.

Their horizontal extent is considerable, and the width sufficient to suggest large bodies of stone in depth; but it is their relation to the lead ores that is the important point to decide.

As regards age, there is excellent evidence to show that the lead veins are of later date than the quartz reefs.

Looking at the face of the open-cut in the North Mt. Farrell Mine from the north, the most striking feature is the clean-cut intersection of the quartz by the lead ore bodies. The "horses" of mullock left standing, in the exploitation of the ore, are belts of slate traversed by very numerous veins of quartz, which dip rather flatly to the west. These veins seem to be part of a more massive body of quartz, which is seen at the surface in more solid form a little further north (at the north end of the open-cut). This body of quartz is typical of the others on the field and here at least is intersected at a small angle by the lead ore veins.

The quartz reefs being older, we may well expect them where fractured to be traversed by the lead ores, and to *contain lead ores where this later impregnation has taken place.*

This is well shown in the case of the Mt. Farrell Mine, with its rich shoots of ore enclosed in quartz. For on this latter section the quartz body is full of vughs, partly filled in many cases with crystalline quartz. A long line of vughs, connected in depth with the main fissure by which ascending solutions have brought up the metallic compounds, seems to have served as the cavity necessary for the deposition of the ore. Where the continuous line of ore-filled vughs joins the main fissure, or how it is connected, remains as yet unknown. The facts that are certain are—that the ore is entirely surrounded by quartz; that other lines of empty vughs occur—empty, because the ascending solutions had no access to them from below—and that where the lead ore occurs siderite is always visible, whereas the quartz away from the galena-

erite veinlets is quite barren, and contains only undi-
ted fragments of slate.

The same phenomena are exhibited by similar quartz
fs in slate on the sections south-west of Thomas' Blocks
th of the Murchison River.

The fractures which have admitted the filling of quartz
re remained, perhaps, still planes of weakness; and
ring subsequent fissuring and impregnation a fracture
allel with the original one, or even coincident with it,
formed and been filled. But the ore-filling is
a totally different type to the quartz impregnation,
l the characteristic mineral of the later invasion of
terial is the carbonate of iron.

Whether the minute fissuring of the porphyroid and
spar porphyry previously mentioned is a part of the
enomena of, and simultaneous with, the filling of the
ger fissures with quartz is not certain from the evi-
ice gathered. However, on the Tullah Mine and at the
ngdon the silicified igneous rock has been refractured
l penetrated by metal-bearing veinlets; and this impreg-
ion show some close resemblance to the secondary
ing of the bodies of quartz. The felspar porphyry has
served more of its character during silicification than
slate; for the quartz reefs seem to have almost com-
tely replaced the slate, and only small fragments of
latter remain here and there embedded in the solid
artz.

E.—THE IRON ORES.

There is a considerable amount of hematite, of both
cular and compact varieties, in many parts of the field.
ch specular ore is scattered through the conglomerate
the Mt. Farrell crest in association with the quartz
nlets.

There is on the north-western flank of Little Farrell a
siderable mass of the older schistose conglomerate
ost completely replaced by a compact red hematite.

Other very massive outcrops appear in the chloritized
artz keratophyre and quartz felsite of the Osborne
cks; and yet another similar to these is the porphy-
d on the northern slope of Mt. Murchison, in Section
'0.

So the impregnation of iron ore is of later date than
alteration of the porphyries, and perhaps of later
e than the conglomerate of the mountain ridge. It is
tainly younger than the latter if the impregnation of
the rocks has been simultaneous.

(3)—The Distribution of Ore in the Lodes.

The internal structure of all the lodes of the field is in most cases very complex, and the ore minerals share in the complexity.

At times there is a distinct banding of the veins, and usually the several bands are parallel to the general direction of the lode. The clean hand-picked "firsts" are obtained from these portions of the lodes. But any one lode will often show both the banded structure and a brecciated structure as well in the same face; and the ore in this crushed portion is usually scattered through the gangue, and the mixture constitutes the average "seconds."

When banded there is not a noticeable alternation of ore and gangue. It is rather a parallel arrangement of galena of varying grain in the majority of cases. In no case did I observe a separation of galena from blende in the banded portions of a spathic vein.

The galena in the pyritic vein of the Murchison River Mine is partly as clean banded ore, which is sometimes well over a foot wide, and part is distributed through the other sulphides.

In the Mackintosh southern section, where J. Geddes is working, the clean ore forms a series of overlapping lenses on the footwall.

The fahl-ore is irregularly distributed through the lodes, even in those where it seems more common.

The copper veins show an even more patchy distribution of the metal through the gangue in the small faces exposed by present workings.

In the North Mt. Farrell Mine, of which the workings are the only considerable ones on the field, there seemed to be no definite pitch of the richer shoots of ore.

There are undoubtedly shoots, for the lode-fracture often is traceable by a seam of pug and the development of siderite on one or both sides in the slate country beyond the point where the galena is present in sufficient amount to be payable.* This is shown by the "No. 1 lode" of the North Mt. Farrell Mine.

Still, the workings are as yet shallow, and more definite information will be available later.

* "Payable ore" is difficult to define for these mines. It may be reasonably stated to be ore of such grade that from 12 to 15 tons of ore will give 1 ton of galena concentrates, *i.e.*, with a width of lode of from 6 to 8 feet.

The way in which the rich patches of first-class ore cut t abruptly is remarkable in this mine. From visit to nit each face shows considerable changes, both in the :al amount of ore and the proportion of firsts.

In my opinion, the presence of the rich bands and ckets of ore is due mainly to the structure of the main d subsidiary fractures in the country rock, and the gree of access to these fractures that has been afforded the mineralizing solutions.

In the Murchison River Mine this structural peculiarity eferred to above in discussing the influence of country) so pronounced that the whole of the payable ore is in ie great shoot enclosed between porphyroid walls, while e fracture continues beyond on either side. In this se the shoot is pitching southwards at an angle of 55°.

With regard to other variations in the ore, there has ready been mention made of the change from a lead a copper-bearing type along the line of the Mt. Farrell-orth Mt. Farrell-Mackintosh fracture. I feel confident at this is one continuous fracture system, that extends ght to the Mackintosh River, although its mineral char-ter alters.

Variations of the ore in a vertical direction cannot be id to have been proved by present workings. There is parently no sign of a progressive impoverishment of the les, nor of the galena being replaced by other sulphides. ie North Mt. Farrell Mine is again the one from which ost information is to be gained; and even here workings e as yet not below the level of the button-grass plain. Still, e lowest workings show no visible falling-off in the nount of first-class ore, even if the assay returns of the sts average slightly poorer.

The Langdon Mine shows a very abrupt passage of lena into almost pure resin blende in a very short ver-cal depth, but the workings are very small, and no neralisation could be made applicable to the district from is occurrence alone. Moreover, future operations might veal at this spot a return of the predominance of lead es over zinc.

(4)—The Structure of the Lodes.

Fissure Veins.

The majority of the lodes of the Mt. Farrell district e what are commonly known as fissure-veins. The term used here in a purely general sense. The nature of the lling, whether metalliferous or not, is not implied, nor

the manner of the filling, nor the amount of actual filling and the proportion of ore due to metasomatic replacement.

It is merely implied that the veins have, on the whole, a tabular form, and that their present location is governed by the existence of pre-existing fractures, which have served as circulation channels to the ore-bearing solutions. These channels have been chosen by the vein-forming solutions as affording the easiest path to regions of lower pressure.

The fissure veins of Mt. Farrell are in no case single simple ones which fill one clean fracture.

The fracture systems are usually complex, and the ore veins are the same.

There may be a single main fracture with subsidiary ones leading into it at various angles. This is so with regard to the Murchison River Mine and the south workings (J. Geddes' tribute) on the Mackintosh leases.

And the main fracture itself is generally rather complicated, consisting of the actual plane of separation and the crushed zone of country alongside. This crushed zone is usually crumpled and contorted to a high degree, and the metallic minerals, galena and blende, together with the siderite, quartz, and remnants of crushed slate, make up the main bulk of second-class ore.

Slickensiding is usually to be seen on the walls of the main fracture, and indicates a relative movement between the walls in a vertical direction. The main fracture usually has a certain amount of pug.

As regards the origin of the fractures, little information can be ascertained yet. The slate in the neighbourhood is much contorted, and overthrust faults can be seen on a small scale; yet how far compressional forces have contributed to the actual fracturing is hard to say.

The fissures, once formed and filled with ore, have certainly reopened in some places, and the further movements have resulted in the brecciation of the lodes. This lode material of brecciated galena and quartz with pug is well shown on the No. 2 level of the North Mt. Farrell Mine at the extreme north end of the workings, where the soft wet puggy ore runs in on the drive.

The "sheeted zones" or "lode formations" which carry the ore in the Tullah Mine and the Tullibardine are similar, save that the fracture is a distributive one rather than simple. A broad belt of the country suffers simultaneous impregnation.

As to whether the limestone country of the White Hawk district carries any fissures of longitudinal continuity, I was not able to determine at the time of my visit.

The galena in the quartz of the Mt. Farrell Mine forms in a sense a fissure vein of lead ore. It is, however, rather different from the other cases in that there have been two distinct periods of filling. The first period was characterized by an absence of metallic ores, and partial cavities, or "vughs" were left in the quartz then introduced. Some of these cavities, of which the directions and dimensions varied a little, were in continuity with each other. They were also continuously connected with the fractures by which the metallic ores were introduced at a later date; so that, while the lead ores are, in the main, deposited in a separate system of fractures, the older fractures have also served as loci for the deposition.

The ore in the Mt. Farrell Mine has been deposited in the heart of the quartz body. On the southern section of the Mackintosh lease (J. Geddes' tribute) the quartz forms the footwall. The fracture in this latter case has re-opened along the western edge of the quartz, which has adhered to and given stability to the footwall. The subsidiary fractures which lead from the main fracture are all on the hanging-wall (western) side of the lodes.

Disseminated Ores.

The disseminations of copper pyrites and galena show no structural characteristics at all. In one case, near the Osborne Blocks' cage, the joints in the chloritized quartz felsite cut across the ore, and are clearly of later date. The primary ore does not follow any visible divisional plane or cavity in the rock.

(5).—The Strike and Dip of the Lodes.

There appear to have been several main directions of fracturing of the crust in the district:—

(1) The main lode-line, which extends from the Mt. Farrell Mine northwards through the North Mt. Farrell and Mackintosh sections, and the Farrell Blocks. The trend of the fracture is, on the whole, a few degrees (9°) east of north; and the dip is between 60° and 70° to the westward.

(2) The Central Farrell and Murchison Extended (North Murchison) Mines are situated on a

fracture system which trends almost due north and south, or a degree or two to the west of north. The dip is west 60°-70°.

(3) The Murchison River lode bears N. 28° E., and thus offers a sharp contrast to the others. It is practically a vertical lode.

(4) On the south side of the river the fractures strike almost invariably west of north. There is little work done, and the figures given must be used with great caution, since they are observations made over very short lengths of lode outcrops, or short development drives. Thomas' Blocks lodes strike about 25° W. of N. The Tullah lode strikes 8° W. of N. at the surface. Foy's lode, near Kittson's, strikes N. 21° W.

(5) The Langdon Mine, to the west of the Tullah town-site, is remarkable in that the lode there strikes due east and west. The dip is to the north.

(6) The northern occurrences at the Tullibardine are very difficult to judge as regards strike, but the prevalent direction of the fractures seems to be east of north about 20°.

With regard to these characters there are a few points of further interest.

The striking feature of the whole system of fracturing is the abrupt change of strike in the case of the Langdon Mine. The existence of an east-and-west fracture in connection with a north-and-south series in this district would not appear remarkable. Here, however, the east-and-west fracture alone appears. There are certainly in the immediate vicinity a few very small fractures running at different angles, but no north-and-south series is visible. The presence of such a fracture system may yet be proved, and its presence seems quite probable from the general structure of the rest of the district.

In the Mt. Farrell Mine the south workings on the western lode show a remarkable series of changes in the strike. From the main adit the lode-channel is driven on for 15 feet on a bearing of 23°. The next 50 feet of driving have a bearing of 9°. Then the lode resumes almost the old course, and is followed for 25 feet on a bearing of N. 25° E. Here a split occurs, and the western drive bears 25° for another 50 feet. The two portions reunite and continue for 100 feet on a bearing of 26°; and then

the lode again returns to its former course of 9°, along which 125 feet of driving has been done.

There seems, then, to be two main directions to the course of the lode—9° and 25°; and the reason for this lies probably in the fact that the slate has a distinct "grain." Some part of the break runs with the grain and some portion across it.

(6)—The Alteration of the Wall-rock of the Lodes by Mineral-bearing Solutions.

Coincident with the introduction of the metals into the fractures, and consequent upon the chemical activity of the solutions which have been the carrying agents, there has been usually some marked degree of alteration of the wall-rocks in immediate proximity to the lodes. The change has been caused by the introduction of fresh material from without, or the the partial alteration of the minerals already present in the country rock.

In the North Mt. Farrell Mine the slate, in its least altered form—away from the lodes—is seen to be a pyritic one; yet near the lodes the iron mineral is seen to be the carbonate. Pyrite is to be seen in the lode itself, but the slate seems to have been freed from the sulphur content near the lode fissure.

The iron carbonate may possibly have been all introduced by the lode-forming solution. But if it has, the pyrite has all been removed from the slate. It seems more probable that the iron has been provided by the pyrite, and that siderite is the result of carbonated solutions reacting upon the sulphide.

Besides this alteration there is a notable development of graphite in some places where the lodes occur in the dark-coloured slate.

The graphite may be an original constituent of the slate, but I could not find it in any spot where the lode-forming influences have not been at work; still, in no case did I observe it in any other rock than the dark slate.

The other characteristic alteration effected in the rocks enclosing the lodes is the development of a waxy micaceous aggregate, which has a smooth or even greasy feel in some cases.

This aggregate is perhaps best termed pinite, in that it answers to Dana's* description:—"A general term

* "A Text-book of Mineralogy." Edition 1899, p. 466.

used to include a large number of alteration products, especially of iolite; also spodumene, nephelite, scapolite, felspar, and other minerals. In composition, essentially a hydrous silicate of aluminium and potassium, corresponding more or less closely to muscovite, of which it is probably to be regarded as a massive, compact variety, usually very impure from the admixture of clay and other substances."

The dark-coloured slates are not visibly altered in this way. No microscopic examination has been made to find whether the alteration has been effected, even though not visible to the naked eye.

In the pale-coloured clay schists, however, the change is well defined. The rock already contains a considerable amount of sericite,† but this is materially augmented, and a yellow to green waxy product results.

This is to be seen on the Mackintosh and Farrell Blocks sections, as well as with both the lead and copper veins of the Tullibardine; in fact, wherever the lodes traverse this clay schist.

The porphyroid suffers an entirely similar alteration, and the spathic type of lode is accompanied by a greater degree of change than is the pyritic.

The country of the Thomas' Blocks main lode is this porphyroid which has been strongly attacked in this way.

In this section the rock still shows the idiomorphic and embayed quartz phenocrysts, but almost the whole of the rest of the rock has been replaced by the pinitic aggregate.

The same is true to a less degree of the country rock enclosed in the lode-formation of the Tullah Mine.

This is the type of alteration which has been termed "sericitization."

Yet another alteration has taken place in the case of the disseminations of lead and copper ore on the Osborne Blocks.

Here a silicification of the chloritized quartz felsites is the characteristic accompaniment of the ores. The silica has proceeded into the quartz felsite, and filled up the minute cracks, and has bodily displaced the igneous rock as well. The invasion of quartz is gradual, and there are no clearly defined lines between the unaltered and altered quartz felsites.

† *Vide supra*, p. 22.

(7)—The Secondary Alteration of the Lodes.

One of the striking features of the Mt. Farrell field is ıe small amount of oxidised ore that has been formed by ıe action of the meteoric water upon the lodes.

The outcrops, where they are visible, are covered with very thin rusty coat, which shows a little—very little—ıd sulphate or carbonate.

As a rule, the outcrops are only laid bare in the stream ls. On the other portions of the hill-slopes the soil-ep brings a cover of the country rock from higher up slope, till the lode outcrop is completely hidden.

So any oxidised crust that could form would tend to ca the surface material on its downhill path, and the ıditions necessary for the accumulation of a gossan have existed since the present physiographic cycle began.

A few ironstained lumps of ore with a core of galena can still picked up in the creek beds, but no gossans are to found of any value or extent. Even the pyritic mass the Murchison River Mine has a very small capping gossan.

Lead carbonate is practically not to be seen. There are few crystals on the Murchison Mine in the ironstone ar the surface. I saw a little on the surface of the rth Mt. Farrell and Mt. Farrell Mines. The White wk Mine contains a little more; but there the country k is limestone and far more permeable by surface-ters.

In no case was there visible any silver chloride or other ondary silver ores.

The quartz reef of the Mt. Farrell Mine containing the ghs filled with lead ore has arrested the downhill creep the ore, and the result is that secondary processes have re been operative. The unfilled vughs have assisted by bling an active circulation of surface waters to attack upper portions of the deposit. Some of the contents this upper portion have been leached out, carried down-ds, and redeposited at lower levels. The lead is rede-ited in the form of octahedral crystals of galena, areas the first-formed ore is invariably cubic in form.

The octahedral galena is found either deposited upon cubical metal in the heart of vughs, or embedded as rly-perfect crystals in a greenish kaolin occurring in kets along the borders of the primary fillings of the ghs. A similar deposition of secondary octahedral lena upon the primary cubical mineral is mentioned by

Van Hise as occurring in the lead deposits of the Mississippi valley.*

But for this case, the lead ores of the field show no sign that can be taken as undoubted evidence of secondary concentration.

The existence of rich shoots of secondary ore has not been proved; and this point is one of great commercial interest. It is frequently stated on the field that the mining operations are as yet "too shallow." The apparent inference is that deeper workings will lay bare richer ore; but such richer ore is only to be confidently expected when a zone of leached ore has been passed through in the upper workings.

The bulk of the lead ore at Mt. Farrell is, even at the surface, practically fresh and undecomposed, and, with the single exception indicated, free from leaching, and not enriched by secondary processes. Still, this fact carries much comfort to mines like the North Mt. Farrell, whose first-class ore can be therefore confidently expected to descend. It is not the result of a local concentration, nor due to the formation of a zone of secondary enrichment that might be expected to give place to poorer ore with deeper development.

The copper deposit on the Tullibardine lease has suffered some degree of alteration, and the copper that has been leached out of the upper portions of the lode has been redeposited, in part at least, in the form of native copper.

This native copper is in a very fine state of division, and is distributed through the ironstained clay schist between the seams of cupriferous quartz.

Its quantity will probably not prove to be considerable. The zone that has, by the leaching processes, provided the native copper is not more than a few feet in depth; and the total bulk of copper ore in the formation cannot be expected to produce much secondary ore.

(8) The Underground Waters.

Before venturing to formulate an account of the mode of origin of the lodes of Mt. Farrell, it will be well to consider the phenomena now presented by the underground waters. For the ores have been undoubtedly deposited from solution, and the origin of the ores is involved with the origin of the solutions which brought them to their present position.

* Van Hise: "A Treatise on Metamorphism," pp. 1145 and 1146.

When the rainfall at Mt. Farrell is taken into consideration the underground workings appear to be remarkably dry. The water that is met with is restricted to the planes of movement of the rocks, and the rock-masses between these fracture-planes are dry.

In the North Mt. Farrell Mine practically the only water that finds its way into the workings is to be seen where the clay schist is in contact with the dark slate.

The lodes are always damper than the country rock. For instance, the Mt. Farrell south workings on the western lode show a good deal of water, and the neighbouring crosscut in country rock is nearly dry throughout.

Moreover, the water makes its way downwards in every case which I observed, with the exception of an occurrence in the Mt. Farrell Mine. This is in the quartz body which contains a number of vughs, as already explained. The main adit on the northern workings has cut across the quartz reef, and a bubbling spring of water appears in the sole of the drive. This spring is directly below the main line of ore-filled vughs mentioned above. But the spring-water is fresh and cold, and is clearly the surface-water that has an intake at some point higher up the hill. The exact channel by which it has travelled is not visible; yet there is probably a main cross-fracture dipping west and connecting in depth with the cavity in the quartz by which the water ascends.

The circulation at this point appears to be free, and the flow considerable; yet it must be remembered that this freedom of circulation was impossible until mining operations penetrated the fractures at a level below their intake. Before mining began the natural circulation must have been very much more restricted.

Even now there are cases that show how "tight" the lodes are. The Mt. Farrell northern workings contain a shaft beneath which a drive on the lode has been put in; and during my visit to the field, lasting over nine weeks, the water had not drained out of the shaft.

It is stated on the field that the amount of water that drains away from the mines does not vary much with the seasonal changes. My visit to the field was too brief to judge this matter by personal observation.

There is no evidence at Mt. Farrell at present available to show the existence of any other water in the mines than that which has fallen on the surface as rain, and which has made its way downwards under the influence of gravity alone. Yet it cannot be granted that this surface-water

can have been the agent whereby the lode-matter has been introduced into the fractures.

For the alterations that have been effected in the wall-rocks, as well as the insolubility of the lode-forming minerals in pure and cold water, lead us to believe that the solutions which produced the lodes were hot, and that they contained salts in solution; and further, that these solutions ascended from deeper portions of the crust by paths of considerable downward continuity. These circulation-channels which offered the least resistance to the ascending mineral waters were the main fracture planes of the district.

The surface-waters have had very little to do with the lodes. Their effect in modifying the mineral composition of the lodes which the ascending waters have deposited has been dealt with under the head of the secondary alteration.

The unoxidised ore being found almost at the surface it is not remarkable that no line can be drawn to show the "ground-water level." This line, which marks the level below which any excavation remains permanently full of water, may be said to almost coincide with the ground-surface in most portions of the field.

In the White Hawk limestone it is naturally at a lower level, but how far down below the adit level it exists was not determined when I visited the property.

(9)—Summary of the Genesis of the Lodes.

As the result of the consideration of the facts dealing with the Mt. Farrell district which have been gathered together, and the comparison of these facts with those now known concerning other mining fields, a brief outline may be formulated of the most probable origin of the lodes. The views of the writer on this subject must be held to be neither original nor unusual. An attempt is made here to apply to the Mt. Farrell field the results of conclusions arrived at by many mining geologists, especially in America and Germany, concerning the origin of ore deposits.

First of all it becomes apparent from what has been said above concerning the independence of country and lode, that the proximate source of the ores must be sought outside the rocks in which they now occur.

The question arises then, "To what portion of the earth are we to look to discover their origin?" And in answer to this question it should first be stated that metallic ores

hich are the fillings of cavities or fractures in rocks at date subsequent to the formation of the rocks themves (*i.e.*, the so-called *epigenetic* ore deposits) have nost invariably been introduced from below.

Looking downwards, we are at a loss to see any rockss which differs from that which contains the lodes on surface, for the development of the mines in depth hardly be said to have been started yet.

Here the geological structure observed is of assistance. The only rock-mass which can be considered to underlie rocks of the field in depth is the granite which outps at Granite Tor, and appears there to be dipping ow the mantle of mica schist towards the west.

The majority of mining geologists are of the opinion t the ore deposits of deep-seated origin derive their tallic contents from plutonic igneous magmas, and that anitic magmas especially are the proximate sources the metallic minerals. The granitic magmas during eir solidification, give off a quantity of mineralized pours and solutions, which ascend by the most accesle channels, and deposit their metallic contents during e ascent.

We know that there is a very large area of Western Tasania underlaid by a granite mass, which at its outcrops Hampshire Hills, Middlesex, Cox's Bight, and Heemsrk is stanniferous.

The country overlying this granite is mineralized in any places, for it is a much-folded, and therefore muchactured area; and some of the minerals found with ther ores show characters which help to connect them enetically with the tin ores. Such minerals are those hich contain boron and fluorine.

The discovery of fluorspar at Thomas' Blocks is of great nportance in this search for the origin of the Mt. Farrell des, for fluorspar is a mineral most characteristic of he lodes, either in granite or in immediate proximity to ranitic masses. It is, for instance, a common gangue ineral in the Middlesex tin-wolfram deposits, and on the orth-east tin-fields is common near the lodes.

The only other mineral which occurs at Mt. Farrell, and hich is a common associate of the typical ore-veins of ranitic areas, is native bismuth, which is quite plentiful t Kittson's workings in the south-eastern portion of the eld. So we may reasonably infer that Mt. Farrell owes a mineral impregnation to the granite which outcrops t the places mentioned.

The agent by which the metallic contents of the lodes were borne to their present position was undoubtedly, in the main, water; but the solutions rising up the lode-fissures were probably of complex composition, and, like the waters of the hot springs of to-day, they probably contained sulphur in the form of sulphides or sulphates of various elements, together with carbonic acid, free and combined. Such heated rising solutions would cause the alterations of the wall-rocks that have been mentioned.

The confinement of these ascending solutions to the main deep fracture-planes is explained by the fact of their deep-seated origin. The deeper fractures would be the ones which would offer paths of less resistance to the imprisoned vapours.

Once formed, the lodes have shared in the general degradation of the region by surface agencies. They have been attacked to some extent by the processes of oxidation, but the accumulation of the oxidized material has been prevented by the physiography of the lode-bearing zone.

VI.—THE MINING PROPERTIES.

(1) The North Mount Farrell Mining Company, No Liability.

The sections held by the company are the following:—4116-93M, 68 acres; 2722-M, 40 acres; 1074-M, 20 acres; 3262-93M, 76 acres; 1867-M, 80 acres; 2351-M, 75 acres; 292-W, 10 acres; and 82-W, 4 acres.

Of these sections, that which is numbered 3262-93M is much the most important, and carries the principal workings and the concentrating mill.

From the accompanying geological map it will be seen that the lodes worked by this company are situated on the western side of the slate belt, and close to the narrow band of pale clay schist.

There are four main levels at which work has been carried out. These are named respectively No. 1, No. 2, No. 3, and No. 4, and are separated by vertical distances of about 60 feet. The workings have disclosed the presence of three main lodes, which converge towards a point situate in the neighbourhood of the open-cut.*

Of these lodes, the eastern one, called by the management the No. 3 lode, seems to be undoubtedly the principal one. It conforms, on the whole, to the general direction of strike of the fracture which runs southwards through the

* See plan of mine workings, Plate IV.

arrell ground and northwards to the Mackintosh
Its continuity is much more pronounced than the
two, and the distribution of ore more uniform.
ıher two lodes are nevertheless valuable assets, for
gh the present output is being maintained mainly
No. 3 lode, the No. 1 and No. 2 lodes will almost
ıly provide much ore with deeper development.
No. 1 lode, situated almost on the edge of the main
ıf slate, and in immediate proximity to the clay schist,
about N. 35° E., and dips westwards at about 60°.
very broad lens of ore, which was first encountered
ving the No. 4 level crosscut.
levelopment it was found not to extend upwards very
above the No. 3 level, where it splits into two bodies
ted by mullock.
the ore has been stoped out of this lode above the
level, with the exception of a small pillar above this

·e has beeen a large body of ore removed, as the
ength of this ore lens is. on the No. 4 level, 240 feet,
has been stoped out for a width of 35 feet in places.
of this ore having been removed, I was unable at
ne of my visit to inspect and note its characters.
·e have been drives put in northward on the line of
de, which is marked out by a slight development
carbonate of iron in the country rock; but on both
ı blank of about 120 feet was met with.
·osscut driven west on the No. 3 level, at a point a
outh of the intersection of this barren channel with
·. 2 lode, met with an ore-body, which is now being
:ted. Assay returns, showing 82 per cent. of lead
ozs. of silver per ton, have been obtained from the
at this point.
body is now being prospected northwards on the
level, and a lode 4 feet wide has been proved. A
ırst-class ore is showing, and the footwall is deeply
sided. On the No. 3 level the grooving of the wall-
as noticeable on the hanging-wall side of the lode,
ı defined footwall was visible.
ıort crosscut was put in to the westward on the
level to test the width of the formation. Some
was met with, but no defined wall. Work is pro-
; along the line of the lode.
ıay be that this ore-body is a continuation of the
lode, but it seems more likely to be a separate
lode from which some ore has been won at the
ı a little further northwards on the No. 2 level.

The only other work done upon the west... is a winze sunk from the No. 4 level on the No. 1 lode. ... has been sunk some 30 feet, but was full of water at the time of my visit.

I am informed that the ore on the No. 4 level for the whole length of the ore-shoot was of good quality; and there seems to be every reasonable prospect that deeper workings will expose a continuation of these values in depth.

The No. 2 lode has a strike about N. 17° E., and the westward dip is steeper than that of the other lodes. This lode has been productive of ore, especially above the No. 2 level, whence stopes have been carried to the surface for 750 feet in length. Recently the track of the ore-channel has been driven on at the No. 1 level, and the strike changes through a wide angle rather abruptly. The fissure seems to be making towards the No. 3 lode-channel as if it would unite with it.

Between the Nos. 2 and 3 levels this central ore-body has been productive for about 400 feet, for which length stopes have been carried for nearly the whole height. Between levels No. 4 and No. 3 there are stopes for a length of 250 feet, but the southern extension of the lode-channel shows ore of poorer grade.

On the No. 4 level the same abrupt change of strike is noticeable as on the No. 1, and there seems no doubt that this ore-channel will join that of the No. 3 lode if traced out in future workings.

The No. 3 lode is the principal source of the ore which is being won at the present time. It is a lode from 15 to 22 feet in width, and a brecciated zone about 6 feet wide on the footwall side.

No hanging-wall at all is to be seen. The boundary of the lode on that side is arbitrarily fixed by the grade of the ore. There seems to be a definite footwall with a seam of pug, but ore is often obtained beyond this wall.

The pug sometimes carries ore, a fact which seems to indicate later movement in the lode-channel. The veinlets of metal in the main body of ore are irregularly distributed: but the larger seams of firsts run with the direction of the channel.

The strike varies in the portion developed from a few degrees west of north to about the same amount east of north.

The dip is between 60° and 70° to the westward.

In developing this lode the prospecting drives have been pushed forward in the brecciated zone on the footw

and have been timbered. The ore is broken out from the lode later, and this ground needs very little timbering.

From this No. 3 lode there still remains much ore to be won from that portion which is already being worked.

On the No. 4 level it has been stoped out for 120 feet south of the main crosscut to a height of 15 feet. Then, on the northern side of the crosscut, there are about 540 feet of stopes from which 18 feet of ore have been removed.

On the No. 3 level there is not so much work done at the southern end. At a point 30 feet north of the rise which runs from the No. 4 to the No. 2 level the stopes begin, and reach a height of 30 feet at a distance of 180 feet from the rise. In the next 180 feet their height rises to 50 feet, and continues at that level above the drive for another 75 feet, where the rise is taken from No. 3 level up to the open-cut. North of this point there is hardly anything more than development work done.

Vertically above these stopes last mentioned (with a vertical height of 50 feet from the level) there is a block stoped out to within a few feet of the open-cut from the No. 2 level, but no further stoping is done on this level. The ore above the drive is practically unknown, and trenches are being put in on the surface to endeavour to locate the outcrop. Since my departure from the field it has been reported that the lode has been picked up.

At its northern end this lode encounters the quartz, which appears to pitch S.S.W. from its outcrop in the open-cut. Beyond this it has not been followed on the No. 4 level, but a drive has been continued northwards past the quartz on the No. 3 and No. 2 levels.

The ore-body changes in character after traversing the silicified zone, and consists mainly of a wet running pug charged with brecciated fragments of quartz, galena, and slate. This is especially noticeable on the No. 2 level, where the ore-body has run in on the drive. This ore resembles that which is worked about 150 feet further north, in the Mackintosh section. The galena is said to be finer in the North Mt. Farrell workings, but the ore does not appear different in general character.

At the south end of the present workings on this lode there is a silicified zone of the slate met with, and the lode seems much disturbed and poor. Still, the channel of the circulation is there, and the development of this end of the property should reasonably prove further payable ore in this direction. The grade of the ore cannot be expected to remain quite uniform throughout, and it should be

remembered that during the earlier days of the mine this No. 3 lode was passed through in a crosscut which penetrated into the country 35 feet beyond the lode, and the presence of the lode was not detected.

At the present time the No. 4 level crosscut is being driven eastwards, and has attained a total length of 900 feet from the mouth of the adit. It is being driven in the hope of meeting with further lodes to the east of the present system.

The grounds for supposing that any ore-bodies occur on the property in such a position that they might be cut by this tunnel seem to me insufficient. The occurrence of lead ore in the quartz reef on the Mt. Farrell Mine is one possessing many singular features, and it would apparently be remarkable indeed if the North Mt. Farrell Mine met with any similar body of ore. As indicated above, and referred to again below, the existence of the vughs filled with ore requires a very exceptional chain of circumstances, and the existence of a separate lode system of any magnitude further to the east is not yet proved.

There is, it is true, a small veinlet of ore on the south-eastern boundary of the open-cut; but I regard this as purely a subsidiary fracture, and not likely to possess any great horizontal extent.

The quartz masses in the slate have been shown to be of separate origin from the lead ores, and the quartz reef on the Mt. Farrell property bends sharply to the north-east, and then disappears on entering the North Mt. Farrell lease. There are other quartz outcrops further north, but while of similar origin to the main masses, their continuity with these is doubtful.

The North Mt. Farrell output is largely made up from their second-class ore. The proportion of first-class ore to seconds is shown in the table below. The concentrating mill has lately been enlarged, and it is estimated that it is now capable of treating from 65 to 70 tons of ore per shift of eight hours.

Mill Scheme.—From the bins the ore goes to the jaw-crusher, which reduces it to a size of 1 or 1¼ inch. Thence it passes to trommels, which separate the fines. The latter go straight to the tables, and the coarse material passes to two topping jigs.

Thence the ore passes to the coarse rolls, which crush it to ⅜-inch, and deliver it to the first sizing trommel. The oversize passes to the second rolls, and the remainder is elevated to the jig-trommels.

There are four screens, whose apertures are as follows:—$\frac{1}{4}$-inch circular, $\frac{3}{16}$-inch circular, $\frac{3}{32}$-inch circular, and $\frac{3}{8} \times \frac{1}{32}$-inch slots. These screens control the supply to the first four jigs; and the fines which pass through the last screen go to the tables.

The middle products of the jigs go to the second rolls.

These second rolls feed the sizing-trommel on the other side of the mill. The oversize (above $\frac{3}{8}$-inch) is returned by an elevator to the rolls. The remainder of the ore passes to the jig-trommels. There are four jigs on this side also, and the material they treat is sized by screens with the same apertures as on the other side of the mill. The fines pass to the tables. The middle products of these jigs go to the dump.

The tables include two Cards, one Wilfley, and one Sperry.

In addition, it is proposed to put in a regrinding plant to deal with the middle products from the tables and second jigs. This addition will undoubtedly greatly improve the efficiency of the mill.

The value of the mine and mill products may be seen from these figures, which are the averages of the assays between the months of July and October, 1907.

	Lead, per cent.	Silver (ozs.) per ton.
No. 3 tunnel, firsts	62·3	64·9
No. 4 tunnel, firsts	58·9	62·8
Jigs	51·1	47·9
Slimes	55·2	44·9

The North Mt. Farrell Mining Co., No Liability.

Comparative Statement, showing Average Results for the Last Seven Half-years.

	October 31, 1904.	April 30, 1905.	October 31, 1905.	April 30, 1906.
Crude ore, total quantity handled	6356·77 tons	6237·13 tons	7838·95 tons	10,294·92 tons
Crude ore, quantity handled for each ton of marketable ore produced	7·24 tons	7·70 tons	9·66 tons	8·75 tons
Crude ore, silver recovered, per ton	9·45 ozs.	9·61 ozs.	6·39 ozs.	6·02 ozs.
Crude ore, lead recovered	8·40 per cent.	8·50 per cent.	6·15 per cent.	6·17 per cent.
Marketable ore, quantity produced	876·79 tons	809·52 tons	811·28 tons	1175·5 tons
Marketable ore, total value at mine	£7393 3s. 5d.	£8905 15s. 3d.	£7371 10s. 0d.	£11,598 1s. 9d.
Marketable ore, net value per ton at mine	£8 6s. 4d.	£11 0s. 0d.	£9 1s. 8d.	£9 15s. 9d.
Marketable ore, average silver assay	68·42 ozs.	74·10 ozs.	61·82 ozs.	52·87 ozs.
Marketable ore, average lead assay	60·83 per cent.	65·51 per cent.	59·51 per cent.	54·07 per cent.

	October 31, 1906.	April 30, 1907.	October 31, 1907.	—
Crude ore, total quantity handled	12,091·53 tons	12,282·05 tons	13,506·1 tons	—
Crude ore, quantity handled for each ton of marketable ore produced	8·51 tons	8·1 tons	7·6 tons	—
Crude ore, silver recovered, per ton	6·19 ozs.	6·33 ozs.	6·91 ozs.	—
Crude ore, lead recovered	6·71 per cent.	6·54 per cent.	7·36 per cent.	—
Marketable ore, quantity produced	1420·68 tons	1501·6 tons	1778·91 tons	—
Marketable ore, total value at mine	£15,872 12s. 10d.	£17,574 9s. 4d.	£21,505 11s. 10d.	—
Marketable ore, net value per ton at mine	£11 3s. 5d.	£11 14s. 0·7d.	£12 1s. 9·4d.	—
Marketable ore, average silver assay	52·69 ozs.	51·1 ozs.	52·47 ozs.	—
Marketable ore, average lead assay	57·18 per cent.	53·53 per cent.	55·91 per cent.	—

(2)—The Mt. Farrell Mining Company, No Liability.

This company holds the following sections:—2409-93M, 80 acres; 2410-M, 80 acres; 2656-M, 10 acres. The main workings are situated on Section 2409, and are situated on the northern and southern boundaries of the section.

There is one well-defined lead-bearing lode on the property, and this is, in my opinion, undoubtedly that which continues northward through the North Mt. Farrell and Mackintosh leases. On this property it is referred to by the management as the "western lode." A considerable quantity of ore has been recovered from the occurrence in the strong quartz reef, which is a filling of a line of vughs with lead ore, and at both the northern and southern workings on the Section 2409 the quartz mass has been prospected.

The Northern Workings.—The main adit starts from the northern boundary, and runs in some 725 feet on a bearing of 109°. It is situated 180 feet above the No. 4 tunnel of the North Mt. Farrell Mine.

The tunnel was started in massive porphyroid, and continued in this for 289 feet. Then followed 49 feet of pale clay schist; and then 225 feet of slate were passed through before the "western lode" was met with.

This lode was driven on northwards for 23 feet. It shows quartz and siderite, and carries some milling ore here and there over a width of 3 feet.

Southwards the lode has been driven on for 175 feet, and in the last few feet a deviation to the east was made to carry the workings under a shaft formerly put down on the surface. Some 20 feet back from the face of this drive, the workings were again carried southwards for 53 feet on the lode. The lode contains from 2 to 3 feet of milling ore, in which bunches of firsts are to be found. There is a well-defined footwall on this lode, which dips to the west at 60°. The hanging-wall was good up to the point where the drive deviated to the east. As in the case of the North Mt. Farrell No. 3 lode, the footwall country here sometimes carries ore behind an apparently sharply defined wall.

The strike of the lode here is between 22° and 25° east of north. As mentioned above, the lode-fissure has two prominent directions of strike in this section, viz., 9° and 25° east of north; and the northern workings conform to the latter direction.

On driving the main crosscut another 88 feet eastwards a big quartz formation with a total width of 50 feet was met with. It dips west at 70°. The hanging-wall is well defined, and the quartz is massive on this side; but on the footwall side there are numerous vughs and fragments of undigested slate in this quartz.

A drive has been carried southwards along the hanging-wall of the quartz on a bearing of 185° for a distance of 159 feet. A little galena was visible now and then at the junction of quartz and slate.

When the main crosscut had been driven 44 feet past the hanging-wall of the quartz body some second-class lead ore was met with. The crosscut was continued another 30 feet, and finally abandoned in a dense pyritic slate like that intersected by the No. 4 level crosscut of the North Mt. Farrell Mine east of the lodes.

From the point where the second-class ore—siderite and galena—was met with, a rise was put up. For the first 16 feet only payable seconds were met with, but these gave place then to clean first-class ore, which continued to within 10 feet of the surface. This remarkable ore-body turned out to be due to the filling of a long line of vughs in the quartz with lead ore. The ore is entirely surrounded by quartz, and the central cavity of the vughs was not completely filled with ore.

The vughs pitch in all directions, and the ore-channel has a most irregular form. The ore from this pipe carries a little carbonate of iron and a compact green mineral, which I take to be a mixture of sericite and kaolin. Octahedral (rarely with dodecahedral modifications) galena occurs on the outer surfaces of the mineral crust, having apparently been deposited on the cubical galena by secondary processes. It also occurs in very perfect crystals in the soft pug and brecciated quartz sometimes found on the borders of the vughs. The whole of the ore at this place shows a brownish stain from the presence of limonite.

At the top end there is some zinc blende with the siderite and green sericite-kaolin aggregate. Most of the ore had been removed from this rise at the time of my visit. A little remained on the level on the north side of the main crosscut in a mixed gangue of quartz and carbonate of iron. There is a spring of water bubbling up on the level from below at this point.

From the south drive on the hanging-wall of the big quartz formation, at a distance of 68 feet from the main adit, an eastern crosscut was driven through the quartz

for 46 feet. An empty vugh was passed through at 21 feet. At 40 feet a body of quartz and siderite was met with, and a rise was put up on it for 69 feet. At the lower end of the rise very little metal was showing, but at the top good seconds were found. The rise was abandoned at 69 feet from the level on account of bad air. A candle would only just keep alight at the time of my visit. This rise was later connected with the upper workings by sinking from the intermediate level.

At a distance of 100 feet from the crosscut just mentioned another eastern crosscut was started from the south drive. It was in some 37 feet at the time of my visit, and was in a silicified zone of slate carrying clean quartz veins.

On the surface above these workings some considerable prospecting has been done. An open-cut 12 feet deep and 18 feet wide has been broken out at a point 40 feet south of the first rise. Veins of clean ore occur in the quartz at this place, and some firsts have been bagged. To prove the occurrence an adit was driven 30 feet lower down, and met with the ore distributed irregularly through the quartz; and 8 tons of firsts were recovered in the work.

Some 15 feet below these workings a short intermediate level has been driven, and good ore proved. These workings are 85 feet above the lower level.

In prospecting the good second-class ore south of the first rise a fresh body of firsts was met with similar to that in the first rise. The work done on this has resulted in the proof of the continuation in depth of this ore to the second rise put up from the lower level. The upper workings are now connected with the lower by this rise also.

This occurrence of ore has been mentioned in an earlier part of this report. It seems to me to be undoubtedly due to the passage upwards of mineral-bearing solutions through long lines of connected vughs in the quartz. The two rises are similar in general structure, but the No. 1 rise carried much more first-class ore. At the intermediate level the ore seems to have been more scattered through the quartz. There appears to be, on the evidence of the two rises, a shoot of first-class ore pitching north at a steep angle.

There is nothing to show the existence of another line of ore-filled vughs, and the present system of prospecting (from the lower level south drive by crosscuts across the quartz body) does not appear to me to be either the least-

expensive or the most likely to prove the existence of other pipes. I should recommend that the prospecting in a southward direction for the ore contained in the quartz be continued on the intermediate level, where the track of the ore is better defined. Any apparent downward continuation of ore could then be prospected at a lower level without the uncertainty which exists at present.

At the lower level I should recommend that the prospecting work be done by driving on the line of the two rises already located, rather than by crosscutting from the drive on the hanging-wall of the quartz-mass. This latter method is nothing more than blind stabbing, and the small horizontal extent of the pipes makes it a very easy matter to miss the ore when within even a few inches of it.

The question of prospecting northwards on this level is worth considering carefully. The ore-shoot appears to pitch in that direction, and the northern boundary of the section is about 400 feet distant.

A shaft was sunk at the outcrop of the western lode for a depth of 50 feet, and abandoned. It contained water at the time of my visit, but was being gradually drained by the south drive on the western lode below it.

At the surface there is some good milling ore, said to be from this shaft, but I could not see the ore *in situ*.

The Southern Workings.—The upper adit level has been put in for a distance of 236 feet on a bearing of 107°. At 207 feet from the entrance a short drive has been put in northwards for 51 feet bearing 21°, and a crosscut driven westwards for 21 feet on a body of second-class ore. The main workings on this level are 29 feet further east, where a drive runs north for 102 feet on a bearing 25°. A rise has been put up for a few feet on ore, and a couple of narrow stopes 3 feet wide taken out. I saw a couple of inches of firsts on the footwall here.

No work was being done on this level at the time of my visit.

The main adit is driven on a bearing of 57° for a total distance of 342 feet. A short drive has been carried northward (bearing 14°) from the end for 25 feet. No ore was met with in this end of the adit. At a point 263 feet from the mouth of the adit the "western lode" was driven on. For 145 feet the bearing is 23°, then for 50 feet it is 9°. At this point a crosscut was driven eastwards.

eyond the crosscut the course of the western lode is 25° E., and at 25 feet past the crosscut the lode splits h a "horse" of slate between the two portions.
he western drive of the two runs on for 50 feet past split on a bearing of 25°. Here there is a rise, which been put up for 40 feet, and two stopes have been en out for a distance of 60 feet on fair milling ore.
hen the two arms of the lode rejoin, and the lode is owed for another 100 feet on a bearing of 26°. The rse then returns to 9°, and the face at the time of my t was 125 feet from the bend.
aken all through its length, the western lode repres about 3 feet of milling ore, and the lode-channel is defined always.

is to this ore-body that the company must look for main bulk of the milling ore of the future. There may ther more concentrated bodies of ore discovered in quartz reef, but their presence is so far unproved.
urther prospecting of the quartz has been done on level. At a point 196 feet from the main adit on the ern lode drive a long crosscut has been put in east- ls for a total length of 334 feet on a bearing of 105°. 217 feet the quartz body was met with. At 264 feet w splashes of galena were met with, and short drives put in for 25 feet northwards and 15 feet south- ls on a bearing of N. 15° W. The metal cut out, and was abandoned.
t 287 feet on the eastern boundary of the quartz her short drive was started northwards, but abandoned being carried for 10 feet.
e eastern crosscut was continued for 50 feet past the tz, and abandoned in dense pyritic slate.
e prospecting was continued on this level from a t 15 feet west of the hanging-wall of the quartz, and feet from the western lode drive. There a drive has carried northwards for 100 feet on a bearing of 2°, from that point the drive turns to the east to cut quartz body. Occasional splashes of galena are to be in the quartz here, but always associated with siderite.
he milling ore from the mine is stacked separately on tip to provide a nucleus for future milling operations.
little work has been done below these main southern kings on the northern boundary of Section 2410, but ing more than slate carrying carbonate of iron is ble. At a point 30 feet from the south-west corner of northern section, and on the line between the two ions a tunnel was started to test the western portion

of the property. It runs for 80 feet on a bearing of 66°, but only chloritised porphyroid, in which some hard silicified zones were found, was penetrated. Some quartz and iron carbonate were visible, but no ore. The tunnel is now used as a magazine.

On the southern section a little surface-trenching has been done at two other spots. On the eastern boundary a little galena is visible in the creek, which crosses the line in several places. This spot is very close to the line of the lodes met with in the Central Farrell property, and the ore-channel may be connected with that fracture system.

Further south a trench 2 chains long has intersected an indefinite formation. The trenches are narrow and shallow, and consequently do not afford much information. There is a certain amount of gossan carrying pockets of carbonate of lime, and in this gangue a few splashes of fahl-ore and copper pyrites are visible. The country rock, to judge from the weathered material intersected by the trench, is slate.

Appended is a table which will give an idea of the grade of ore from this mine. It has been compiled from the sale notes of the company.

SALE NOTES OF ORE FROM THE MT. FARRELL MINE.

Date.	Net Weight.	Assay Value.		Total Value per Ton.	Metal Quotations.	
		Lead.	Silver. (oz.)		Lead (per Ton).	Silver (per oz.).
	tons. cwt. qrs.	per cent	per ton.	£ s. d.	£ s. d.	d.
Nov. 27, 1906 ..	6 15 3	71·8	91·9	27 8 7	19 5 0	35 — 54
Jan. 7, 1907....	31 19 0	69·6	94·6	27 11 10	19 18 9	34 — 80
Feb. 8, 1907....	22 10 1	67·5	91·0	26 2 5	19 13 9	33 — 85
May 3, 1907 ...	16 12 1	70·0	92·7	26 18 2	20 5 0	32 — 97
May 3, 1907 ...	17 19 3	69·1	97·6	27 8 0	20 5 0	32 97
May 27, 1907 ..	12 4 1	65·0	90·5	25 3 11	19 15 0	32 — 77
June 7, 1907 ...	14 12 3	67·5	90·0	26 6 4	20 7 6	33 — 50
July 17, 1907 ..	8 16 0	60·4	80·0	23 5 1	20 2 6	33 — 30
July 17, 1907 ..	8 17 3	56·2	74·0	21 17 1	20 10 0	33 — 51
July 22, 1907 ..	8 19 3	56·4	76·9	17 18 8	20 12 6	33 — 71
Aug. 28, 1907 ..	19 12 2	54·4	72·2	16 6 10	19 12 6	33 — 70
Oct. 31, 1907 ..	13 13 3	67·9	97·1	21 16 4	20 1 3	31 — 82
Oct. 31, 1907 ..	7 11 1	66·4	92·3	19 5 3	18 5 0	30 — 28
Dec. 13, 1907 ..	5 4 3	57·0	72·1	17 12 11	15 15 0	28 — 85
Jan. 16, 1908 ..	5 6 2	53·2	74·6	16 7 9	14 11 3	27 — 80

3)—The Murchison River Silver and Lead Company, No Liability.

The company's leases are the sections thus numbered:—263-93M, 60 acres; 1980-M, 80 acres; and 1286-M, 5 acres. The latter is the mill site.

Of the two sections on which mining operations are ried on, that numbered 3263 carries the principal rkings.

The lode which has been exploited on this section has strike of N. 28° E., and is very nearly vertical, dipping anything to the east; so its structure is quite distinct m that of any other of the lodes of the field thus far loited.

The lode-fissure traverses obliquely a belt of porphy-l, which is at this point 70 feet wide, and strikes due th. On either side of the porphyroid is slate, and the of the igneous belt is about 70° to the west. The ductive portion of the lode-fissure is that which is losed within the walls of porphyroid. The lode-channel nds into the slate at both ends, but little has been e to prospect these northern and southern continua-s.

The lode has been worked by means of an open-cut and high-level adits near the ov'-- - and one low-level which starts almost on the level of the button-grass in and intersects the lode some 87 feet below the level ve.

At the time of my visit the mine was inactive, pending reconstruction of the company.

The recent work has been restricted to the open-cut and block of ore between the No. 3 and No. 2 levels.

Above the No. 2 level almost all the ore has been stoped t.

No. 1 *Level.*—The adit at this level was driven eastrds on a bearing of 279°, and was continued right rough the main lode into the country beyond.

The main lode matter has now been removed. Further the east there were two minor veins of ore from which little mixed blende and galena have been obtained. ese are apparently branches of the main lode, and their p is towards the latter.

No. 2 *Level.*—The adit was driven on a bearing of 277°, d 40 feet below the upper one. The ore above this level s been almost wholly stoped out.

No. 3 *Level.*—The main crosscut was driven eastwards a bearing of 260°. Its total length is 513 feet, of which

the first 450 feet were in slate and the last 63 in the porphyroid. At this point the lode was cut, near the northern extremity of the shoot. A drive has been carried both north and south on the ore-channel.

At a point 27 feet north of the main crosscut the ore-shoot was left, but driving was continued for another 75 feet. The lode-fracture is well marked by a seam of pug an inch wide. There is a little galena on the footwall, but no payable ore was met with. At the northern end of the drive a short crosscut was put in to the west, and the porphyroid encountered, but no galena was visible, and work at this end of the drive was abandoned.

The south drive has been extended for 109 feet on a bearing of 210°. The lode pinched out when the porphyroid country was left at a point 106 feet south of the main crosscut. The lode thus extends for 133 feet in a horizontal direction. At a point 53 feet south of the main crosscut a crosscut was driven west for 25 feet on a bearing of 305°. There a short drive was started north and south parallel to the main drive. Some blende galena and siderite was here visible for a width varying from a few inches up to 2 feet. The metal seems to make toward the main ore-body, with which it should junction about 20 feet above the level, the dip being easterly.

The ore in these short drives (12 feet on either side of the eastern crosscut) is displaced by a slide, which is also visible in the main drive. The slide dips south at an angle of about 50°, and the displacement of the lode is apparently about 4 feet. The lower portion of the ore is moved to the west of the upper portion by this amount. The eastern crosscut was continued for another 45 feet eastwards. The porphyroid country was left at a point 4 feet east of the south drive, and the rest of the crosscut is in slate.

These eastern workings were abandoned, as the only ore met with (in the east drive) was lost after being followed a few feet.

At a distance of 109 feet from the main crosscut the south drive turns slightly, and from this point to the end the bearing is 184°. This change of direction is noticeable, as the drive followed the lode-fracture all the way. It would appear that the fissure which traverses the porphyroid at an angle of about 30° from the north and south line is merely a local variation. The fracture in the slate does not differ materially in strike from other fissures in the field. This matter is, of course, important

future prospecting work, both in this section and those joining.

At the bend in the south drive a winze has been put wn on ore for a vertical depth of 56 feet, and a drive feet long put in northwards at 50 feet.

The winze was full to the collar of water, and I could t inspect these workings. It is stated that a slide was ɜt with at this point; and possibly it may be the same de visible on the level 56 feet north from the winze, and tching in this direction.

At a point 29 feet south of the winze an easterly cross- t was put in some 10 feet without meeting ore; and 8 et further south another crosscut was driven west for feet with similar results. Beyond this latter crosscut e south drive extends some 24 feet. The face shows rbonate of iron with galena and blende. The dip is to westward, at an angle of 60°. The footwall is dense l hard slate, but the hanging-wall slate is graphitic, and carbonated zone extends into this crushed graphitic e for about 4 feet.

The main ore-shoot, *i.e.*, that portion of the lode-chan- enclosed within the porphyroid, is said to have given ellent ore all along the level. The average width of t-class ore is said to have been 10 inches, while 30 inches clean ore were met at a point 20 feet north of the ze.

This being correct, there remains a fair bulk of good to be yet extracted below this level.

Above the No. 3 level, and between it and the No. 2 el, some ore has been stoped, but the greater portion remains untouched. It does not extend to the surface, wever, for the shoot is pitching to the south at an angle about 55°.

The shoot was met with on the No. 3 level, at a vertical pth of 87 feet below the No. 2 level, some 60 feet further ɜth than the corresponding point above.

The width of the lode exposed in these stopes varies ɔm 4 to 7 feet. I saw some good first-class ore along e western boundary of the lode-formation, but the bulk the ore consists of massive mixed sulphides of the type own as a "pyritic lead ore." The mineral composition s been noted above.

The work done up to the present has proved a roughly ctangular block of ore, extending from the surface to at ast the No. 3 level, and from 4 to 7 feet in width. The her dimension is about 100 feet; but the pitch of the

shoot makes the length appear some 30 feet greater when measurements are made along a horizontal line.

It yet remains to be proved whether the structure of the lode will alter in depth when the porphyroid zone is penetrated. The nature of the fissure in this rock seems to have entirely controlled the circulation of mineral-bearing solutions, and the slate contains but little mineral matter; but the fissure, of which the upper portion is in porphyroid, must, if its strike and dip continue uniform, pass through slate in depth.

A trench has been made to the south-east of the open-cut for a length of a chain. Some vegetable soil containing a little bog iron ore is exposed. I do not think this is the capping of a lode.

The company has erected a mill on the button-grass plain to concentrate their second-class ore.

Mill Scheme.—The mill is divided into two sections—coarse and fine. From the bin the ore goes to a jaw-crusher, and thence to a trommel, the screen of which carries holes of 13 m.m. diameter. The fines run on. The coarse goes to a picking-table and then to the coarse rolls. There is a topping-jig below taking the "roughs" from the first sizing-trommel (screen apertures 13 m.m. diameter). The tails from the jig are elevated to the coarse rolls, and pass again down the mill. The four sizing-trommels have apertures in the screens of 13 m.m., 9 m.m., 5 m.m., and 2½ m.m. in diameter respectively.

From that which holds the material over 9 m.m. in diameter the ore passes to two jigs. Each of the other two trommels feeds a separate jig. The ore before reaching these latter fine jigs is passed through an upward current separator, and the fines go on to the tables.

Below the last trommel are two spitzkasten, giving two grades of ore. The coarser goes to a Wilfley, and the finer to a Phœnix-Weir table.

Middlings from the table are elevated, and pass to the water-classifier on the fine side of the mill, and are again passed over a Wilfley table.

On the fine side of the mill the procedure is this:—The second products from all the jigs are wheeled back to the elevator, and thence go to the fine rolls, and then the second series of sizing-trommels, the screen apertures of which measure 4 m.m., 2½ m.m., and 1½ m.m. The ore that is caught by the 4 m.m. trommel is returned to the fine rolls by the elevator. The other two trommels supply ore to two jigs.

The ore leaving the last trommel runs to an upward ırrent classifier. The coarse product is treated by a jig ıd the fines pass to the spitzkasten, and then to a Wilfley ıble. The middlings from the table are returned to the ›itzkasten, and then again to the table.

The concentrates from the mill are mixed with the hand-icked ore to constitute the saleable ore. No distinct rades of mill concentrates are made.

The following assay returns will give a reasonable epresentation of the value of the mine products. They re from the assay books of the company, and the assays ere made during 1907:—

Description of Ore.	No. of Assays Averaged.	Lead.	Silver. (oz.)
		per cent.	per ton.
ıan (from open-cut)	6	..	34·5
de ore	14	5·9	11·6
ıd-picked ore	9	51·9	67·4

Sales of Ore by the Murchison River Silver and Lead Co., N.L.

Date.	Quantity of Ore.	Lead.	Silver. (oz.)	Gold. (oz.)	Net Value. (per ton.)
	tons. cwt. qrs.	per cent.	per cent.	per ton.	£ s. d.
, 1907.	12 7 3	43·75	57·1	·045	12 10 1
, 1907.	57 0 1	47·85	64·1	·043	14 1 3
, 1907.	80 14 3	42·8	55·55	·07	12 6 3
, 1907.	32 9 1	43·8	55·75	·057	12 8 10
, 1907.	33 18 0	43·95	59·15	·06	13 4 6
, 1907.	16 17 1	41·3	55·6	·078	12 8 0
., 1907.	31 7 3	28·5	40·9	·095	8 11 9
., 1907.	29 8 1	34·825	47·15	·09	10 8 6

The other lease held by the company, viz., No. 1980, that which was formerly known as the Central Farrell. On this lease there are two parallel lodes, which have en prospected at two levels; and a trench has been t for a chain where a creek has cut across the outcrop. The lodes are separated by a narrow band of porphy-id, and are themselves in slate. The dip of the country westward, and the lodes follow this dip, which is from)° to 65°.

At the surface the strike seems to be about N. 4° W., but the underground workings show the strike to be due north and south.

The creek section shows slate on the western side, with a lode 2 feet 6 inches wide to the east of it; then 9 inches of slate, followed by 10 feet of porphyroid. The footwall of the porphyroid shows quartz, which may mark the position of the eastern lode; but the work has ceased at this point. The lode formation shows a little fahl-ore, now much decomposed and discoloured.

The upper tunnel is driven eastwards on a bearing of 266°, and passes through slate and crushed grit. The total length of this crosscut is 234 feet.

At a distance of 126 feet from the mouth a drive runs due north on the first ore-body. A rise has been put up for 15 feet at a point 110 feet from the main crosscut, where a little metal was met with. Some 34 feet north of this point a winze has been put down. It was full of water at the time of my visit.

At a distance of 29 feet north from the winze a crosscut has been driven for 23 feet, where the second lode was encountered, and driven on for 20 feet northwards. This lode is 4 feet wide, and has well-defined walls. The lode-matter is graphitic slate, with numerous veinlets of carbonate of iron. The footwall is a hard siliceous slate.

The main drive was carried for 33 feet north, past the eastern crosscut, and still on the lode-channel, which shows quartz, siderite, and a little galena. The width of the zone of crushed graphitic slate carrying these minerals varies from a few inches up to 3 feet 6 inches.

The main crosscut did not meet with any ore after traversing the second lode.

The lower-level workings are 60 feet above the button-grass plain, and 50 feet below the upper workings. The adit level is driven for a total distance of 285 feet, and intersects both lodes.

The first was cut at a distance of 212 feet from the mouth of the adit, and there are 15 feet of country between it and the second lode.

The first lode was driven on northwards for 15 feet. The lode-formation appears to be about 4 feet in width, and similar to that on the upper level, but no galena was visible. The drive was abandoned here, and the lode driven on southwards for 73 feet. The formation is well defined all the way. It is about 4 feet wide, and has clean walls. Very little

metal is now visible, but a few splashes of coarse-grained galena occur near the south end on the back of the drive. None was showing in the face.

A drive was started on the eastern lode and carried 6 feet before being abandoned. The lode is well marked, and is in graphitic slate. The ore is accompanied by veins of quartz and siderite, and consists of galena, resin, or ruby blende, fahl-ore, and copper pyrites. The fahl-ore would account for the high assay values which have been recorded of the ore in this mine.

No work was being done on the section at the time of my visit, and the old workings were very much discoloured. The amount of ore in the mine could not be determined, nor the proportion of fahl-ore to the galena. The only spot where any appreciable amount of metallic minerals was visible was at the point where work has been done on the eastern lode on the lower level. There I saw a vein of an inch and a half of the fahl-ore at the sole of the face.

Some rich returns are said to have been obtained from the ore taken from the winze on the upper level. In all, about 120 feet of backs would be obtainable from the lower level to the highest point of the outcrop.

(4)—The Murchison Extended Mine (late North Murchison).

The company holds one section (No. 1075-M), which is registered in the name of E. T. Midwood.

There is a fair amount of surface prospecting work done on this section, but no payable lode has yet been located.

Near the centre of the western boundary-line there has been some trenching along a creek which runs westwards, and a little galena has been disclosed. A main adit has been driven east on a bearing of 91° for a distance of 143 feet.

At 120 feet a lode was met with. This is a brecciated zone of black slate, in which much siderite is visible, and a little galena and fahl-ore. It seems highly probable that this ore-body is on the line of the Central Farrell fractures, but whether a second lode corresponding to that in the Central Farrell property exists I could not determine from the work which has been done.

A considerable amount of trenching has been done on the southern boundary of the section. Some carbonated black slate has been located which carries some pyrites and traces of galena.

Further east of this place trenches have been carried up the hill in steps to a height of 430 feet above the button-grass. The top few feet show a silicification of the country rock, and in the quartz veins a little chlorite and pyrites, but no galena. The occurrence seems similar to that in the South Murchison eastern tunnel. I could see no galena nor any siderite associated with the quartz. The occurrence does not seem to me likely to prove of commercial value. The bearing of this quartz zone is about 175°.

(5)—The Mackintosh Copper and Gold Mining Company, No Liability.

The company holds two 80-acre sections, viz., Nos. 3221-93M and 3223-93M.

The workings on these sections have been carried out in both lead and copper-bearing lodes, which are situated along a line on the western portion of the two sections.

The most southerly workings are in the extreme south-west corner of the southern section, and within 150 feet of the most northerly workings of the North Mt. Farrell Mine. The ore-body is clearly a continuation of the North Mt. Farrell lodes, and it seems continuous right through this southern Mackintosh section and part of the northern.

The company has let several tributes, and the most southerly workings are being carried on by J. Geddes and party.

An adit is driven eastwards from the western boundary-line of the section on a bearing of 91°. The country traversed is all slate, and before meeting the main lode three minor lodes were cut and driven on for a short distance. All of these appear to be merely branches of the main lode, and their strike is N.W. and S.E. From the second branch-lode a rise has been put in to the surface. No work was being done on any of these occurrences at the time of my visit.

The main lode was driven upon southwards for 2[illegible] feet on a bearing of 9°. A rise has been put to the surface and a winze sunk on the ore. There are said to be from 1 to 6 inches of first-class ore here, and with it a few feet of seconds.

The dip is to the west, and the footwall is of quartz, and barren.

The width of the lode varies from 4 to 9 feet. Stoping is being carried on at a point 25 feet from the south

boundary. The formation is a brecciated zone of quartz and galena, and fragments of slate scattered through pug. Some first-class ore is found on the foot and hanging-wall side. The better ore is said to be on the hanging-wall. These veins of firsts are usually in short overlapping lenses.

The present stopes are 30 feet above the level, and there are another 100 feet of backs between the workings and the surface. The ore is partly bagged in the stopes, and the best seconds are hand-jigged.

Some second-class ore is left in the stopes for filling, and the remainder is stacked on the tip with the seconds from the jigs.

The following table compiled from the sale-notes of the tributors shows the grade of ore, and its value:—

Date	Net Weight of Ore.	Assay Value.		Total Value (per ton.)	Metal Quotations.	
		Lead.	Silver. (oz.)		Lead. (per ton.)	Silver. (per oz.)
	tons. cwt. qrs	per cent	per ton	£ s. d.	£ s. d.	d.
June 11, 1907 ..	10 1 1	53·0	54·3	20 7 2	20 15 0	32·00
July 23, 1907 ..	11 6 0	58·2	68·7	21 19 8	22 0 0	32·06
Aug. 19, 1907 ..	11 11 3	58·5	73·4	21 12 7	19 15 0	32·94
Sept. 20, 1907..	15 9 2	60·5	78·8	22 13 6	19 17 6	32·44

In this southern section of the Mackintosh property there are two other places where the creeks have exposed ore, and it is probable that they are on the same lode as that worked by J. Geddes and party.

In these, no work was being done at the time of my visit. Some good second-class ore was visible in the workings, but the lode is not suitable for a small tribute party, although it could doubtless be profitably worked on a larger scale. The lode-stuff in both of these workings is similar to the bulk of the good second-class ore in the North Mt. Farrell Mine.

In the south-western corner of the northern Mackintosh section two lodes have been located by trenching in a creek. A tunnel has been driven from a point a little further west. The bearing is 113°, and the country is clay schist for the first 52 feet. After traversing 81 feet of slate which lies east of the clay schist, this tunnel intersected the first lode. Here good ore is said to have been met with, and a few stopes have been carried almost to the surface, some 85 feet above the level. The first-class

ore was sold and the seconds stacked on the tip. The stopes are 40 feet long, and a rise from over the adit was taken right to the surface.

The drive on the ore-body has a bearing N. 10° E. It has been extended southwards for 20 feet, but northwards for 90 feet. The greater portion of this level is full of water dammed up by a heap of mullock, and consequently inaccessible. The lode-channel seems to be well marked, though the lode varies. The footwall is well defined, and on it the first-class ore is obtained. The hanging-wall is indefinite, and a shot put into the apparent country may at any time reveal ore.

At winze has been put down at a point a few feet north of the main crosscut to a depth of 26 feet.

The ore-body here dips more steeply. It is 8 feet in width, carrying about 6 inches of clean firsts on the foot-wall side and a band of some inches of pug, which contains brecciated steel-grained galena. This latter is hand-jigged.

During my visit some work was done by a tribute party on the ore in this winze, but the water could not be kept under and the party were compelled to abandon the tribute. Nothing could be done with the second-class ore, although it was of splendid grade. Of the hand-picked firsts and jigs some 3 tons of ore were sent away. The average value of this ore is said to have been £16 per ton.

Fahl-ore is mentioned as having been seen in small amount in the ore taken from this lode.

The main crosscut has been driven another 100 feet eastwards beyond the first lode. At 42 feet from the latter a second lode has been cut carrying second-class ore. This has been driven on for a short distance north and south. The lode here appears to be making towards the first lode, with which it would junction at a point further south. A shaft was started in this ore-body at the surface, and is said to be down some 36 feet. Some good second-class ore is tipped round the collar of the shaft.

The Mackintosh property, therefore, seems to carry a length of lode and lead ore of such grade that mining operations on a large scale would be highly profitable. It does not possess the topography that would make the mining on a large scale possible without the sinking of a shaft; yet the bulk of second-class ore and the readiness with which it could be concentrated are in favour of this treatment on an extensive scale. The ore is physically well adapted to concentration, and closely resembles the North Mt. Farrell second-class ore. The present inactivity on this property is deplorable.

At a point further north in the northern section of the Mackintosh lease, and 250 feet from the western boundary, two lodes have been exposed in the bed of a creek.

The country-rock is a pale clay schist, which has been silicified, and which carries also veins of quartz. There is a little carbonate of iron with the quartz, and the metallic minerals present are iron and copper pyrites. The ore is dense and hard, and the copper pyrites is found disseminated in fairly coarse blebs throughout a zone about 8 feet wide. The strike appears to be a few degrees west of north, but very little work has been done, and it is difficult to ascertain the strike and dip.

A shaft has been sunk at a distance of 25 feet from the creek on its northern bank to a depth of 35 feet. It was full of water when I visited the property. The country-rock is the same as that exposed in the creek, viz., clay schist.

The slate is 50 feet to the east of this shaft, and although a number of trenches have been cut in the creek bed on the east of the copper lode no trace of mineral has been found.

On the western side of the lode above mentioned, and distant about a chain, there is a second copper-bearing zone, of a similar character. It is some 3 feet wide, and carries both iron and copper pyrites.

This is the most southerly point at which copper is visible along this line, *i.e.*, in the absence of a much larger proportion of galena.

It does not appear from the work so far done at this point that the ore will give profitable returns as a copper proposition. The occurrence is, however, worthy of being further prospected.

(6) -The Farrell Blocks.

The company known as "The Farrell Blocks" holds two sections, which are registered in the name of E. Goldsmith, and are numbered 2397-M, 79 acres, and 2820-M, 80 acres.

On the western of these two sections (No. 2820) no work has been done. There does not seem much prospect of the Mackintosh lead lode passing into this ground at a reasonable depth. The dip is certainly to the westward, but the winze put down on the western Mackintosh lode shows that the tendency of the lode is to become more nearly vertical than it was between the adit level and the surface; and the lode is distant about 350 feet from the western boundary of the Mackintosh section.

The northern section, No. 2397, occupies a better position with regard to the lode system.

On the boundary-line between this section and the northern Mackintosh section there is a small quartz blow which may be connected with the outcrop cut by the creek a short distance northward; yet the whole area here is highly contorted, and the creek beds show quartz veinlets, which run in all directions, and many of these carry no trace of metal.

In the south-west corner of the section a lode-formation has been cut in a small creek. It is a zone of highly-contorted clay schist, which has been impregnated with silica, and which carries copper and iron pyrites. A little galena is visible in the lode.

On the northern bank of the creek, some 30 feet away, a shaft has been put down 30 feet. No metal was encountered in sinking. The rock penetrated was the clay schist very much contorted, and carrying a little carbonate of lime. The shaft is now full of water. Some 65 feet of backs could be obtained here by driving an adit from the west, but such work is not at present justified. A crosscut from the bottom of the shaft would also prove the lode. However, until the lode is proved to be continuous by other trenches at the surface, the exploitation at a depth should be held over.

Trenches have been cut in the bed of the creek which traverses the middle of the section for a distance of about 7 chains. The country rock exposed is for the most part slate, which is very much contorted. It is sometimes graphitic, and contains a little siderite and veins of quartz. The latter are flat veins dipping mostly to the east, or follow the contortions in the slate. No metallic mineral other than iron pyrites was visible in the main part of the trenches. However, in the southern end of the workings, near the junction of the slate and clay schist, some good galena was obtained. It cut out in the bottom of the trench, however.

The work done at this point has clearly been influenced by the idea that the galena can only be expected to be found within the slate boundaries. The trenching has here been carried out to the east of the proved line of fracturing of the area, and I should recommend that in future prospecting the trenches be continued for a short distance to the west of their present extent. It is possible to obtain 60 feet of backs at the point where the galena was met with in the trenching by 150 feet of driving from

point a little lower down the creek. Still, the trenches ıight be extended westwards with much less expenditure.

(7)—The Sections on the North-western Flank of Mt. Farrell.

On Section No. 3010, which is registered in the name of). Powell, some trenching has been carried on on both anks of a large creek which runs through the section, but ithout result. The section lies to the east of any lodes ɜt discovered.

On Section 2905, which adjoins the northern section : the Mackintosh property, a trench has been cut in the eek bed, but abandoned in river wash, which consists of agments of conglomerate from the mountain.

In the south-eastern corner of Section 2909, on the east- n side of the Mackintosh River, some trenches have been ıt in the bed of a small creek. The river bank is very eep at this point. The upper trenches expose a highly ɔntorted graphitic slate, with irregularly distributed ɜins of quartz, siderite, and galena. Some of these veins ip west and others flatly to the south.

On the water's edge a few shots have been put into the ank, and show the same clay schist which is found in ɔntact with the slate all along this line; and in the rock re a few scattered splashes of galena. No further work as been done on the section.

Passing northwards along the eastern bank of the Mack- ıtosh River the next two sections are registered in the ame of G. E. Butler, and are numbered 2796-M, 80 acres, nd 2892-M, 40 acres.

On the 80-acre section some work has been done in the ast near the northern boundary. At the time of my visit othing was being done.

The fault-plane referred to above traverses this section, nd a creek is situated on the line of the fault. Some enching had been done in the slate near the track, but ıe sides had fallen in, and nothing was visible of the ottom. A tunnel has been started into the mountain nd driven 30 feet in a direction bearing E. 16° S. The ınnel was begun in a coarse quartz grit, and was aban- oned when the massive conglomerate of the mountain as encountered in the face. There are some quartz veins ı the grit carrying iron pyrites, and in one place, near he entrance, some galena.

However, there does not seem to me much inducement ɔ continue driving, in spite of the presence of a small

amount of galena; for what metal was discovered was enclosed within a member of the slate series, and it has not yet been proved that any of the lode-fissures are continuous into the massive conglomerate. This section was formerly known as the "Metropolitan."

At the extreme north end of the mountain, on Section 2873-M, registered in the name of C. R. Lynch, some work has been done to try and locate an ore-body said to be visible in the river at low-water. This latter was not to be seen during my visit. A short tunnel has been driven in the river bank with a bearing of S. 12° W. The work has revealed slate with quartz and iron carbonate veinlets, but no galena could be detected. The tunnel runs with the cleavage of the slate, and a crosscut has been put in towards the east for 14 feet. The slate here, too, carries quartz and siderite stringers.

A trench above the track on the Mt. Farrell side of this tunnel shows only slate.

On the eastern boundary of the section, near the cage crossing to the Tullibardine area, a short trench has been cut in a crushed grit carrying arsenical pyrites. The weathering of this mineral has produced some limonite at the surface; but no sign of a defined ore-channel was visible when I last saw the work.

The position of this section appears to be a little to the east of the line of fracturing of this area.

(8)- The Tullibardine Company.

The company holds three 80-acre sections, all of which are registered in the name of J. McPhee, viz., Nos. 2058, 2592, and 2593.

The greater portion of these sections is covered by unconsolidated river wash, through which the main creeks have cut their way and exposed the underlying rocks.

The felspar porphyry forms a series of steep hills on the western boundary of the property, and the rock underlying the river alluvial is slate or pale clay schist. The strike of the belt of clay schist is, as far as could be determined, considerably east of north. Whether it is the northward continuation of the belt of similar rock which traverses the Mackintosh and Farrell Blocks sections I could not on this visit definitely decide. However, I think it will prove to be portion of what was originally one continuous formation dislocated by the fault which traverses Section 2796. The fault-plane will, I think, be found to be the spot at which the strike changes. If so, the fracture system which has controlled the position of

the ore found on the Tullibardine is probably portion of the same fracture system as that which traverses the Mackintosh area and the Farrell Blocks, and which has been traced to the river bank in Section 2909. In other words, the lode channel, as well as the country rock, has probably been dislocated by the fault which cuts across the country on Section 2796.

In the Tullibardine area the slate occurs on the west as well as on the east of the clay schist. This was the case on the North Mt. Farrell lease (3262), but at the northern locality there is a much greater thickness of slate on the western side.

The main workings are situated in the south-eastern corner of the central Section, No. 2058, on the banks of the large creek which traverses the section. The creek takes a sharp bend from an easterly to a southerly course at this point, and a face has been broken down from the southern bank just at the turn. This cut is 25 feet in length, and exposes the country to a depth of from 5 to 12 feet below the surface-soil. The clay schist is very waxy in appearance, and carries numerous intersecting quartz veins, which carry copper pyrites and some secondary copper ores. The quartz veins vary from half an inch up to a foot in width, but they make and pinch within very short distances. The country rock contains greenish patches, the green colour being due, not to copper, but to a green sericitic mica.

In a complex lode-formation of this character the strike and dip are difficult to estimate. One very strong vein, which has been followed down in a winze, strikes N. 25° E., and dips east at 80°; but other veins dip towards the west.

The copper pyrites is very clean and free from iron pyrites, and is in places quite coarse and massive; and, resulting from its alteration, malachite and bornite are common in the lode-formation.

A winze has been put down on the eastern end of this face for 7 feet. The same types of country and mineral vein persist. In addition, the schist is thoroughly impregnated with very finely divided native copper where it is enclosed between a cupriferous quartz vein and a plane of separation along which surface waters have been circulating. The schist is at this place deeply stained with limonite.

A little further up the creek to the westward a couple of small cuts have been made in the bank, and show a little copper pyrites. One of these veins shows a fair

amount of ankerite* with the quartz, and serves to show the connection between the copper ores and the lead ores. At this place, 15 feet west of the main face, the clay schist has a belt of slate intercalated with it. The slate dips to the westward.

In all, the veins which show copper extend to a distance of 100 feet west of the main face exposed.

Across the creek from the main cut there are two trenches which show quartz veins or silicified schist carrying copper ore. These serve to indicate that the copper bearing zone is at least 150 feet in width.

Where the creek turns to run southwards there is a strong quartz vein carrying coarse copper pyrites. On this, Pearce, who first held the property as a reward claim, had sunk a shaft 20 feet, but the creek at the time of my visit made it impossible to investigate this work. Pearce had apparently turned the creek to the west, but the later work had thrown it over again, so that the water could not be baled out of the shaft.

Alongside this old shaft a tunnel has been driven eastwards on a bearing of 126° in slate, which here junctions with the clay schist. The cleavage-planes of the slate at the entrance of the tunnel dip at 60° to the east, but in the face they dip at 80° to the west. The slate, considered as a whole, will be found, I think, to dip to the west, as does the small band intercalated in the clay schist.

At 75 feet the tunnel cuts through a band of silica 2 or 3 inches wide, and striking N. 5° W.

Further in, 8 feet from the face, the country becomes fractured in all directions, and the fractures are filled with siderite. In the face, further veins of quartz appear striking from 30° to 40° east of north. These quartz veins carry copper pyrites and some odd splashes of galena. The tunnel was here abandoned.

Another tunnel was started, 100 feet south of the first and across the creek. It was driven west on a bearing of 299° for 35 feet, the intention apparently being to prove the veins of cupriferous quartz exposed in the main cut on the creek bank. The only copper veins met with were some small ones in the approach. The country intersected by the tunnel is clay schist, much crushed and fractured. Some bands of the schist are a little darker than others, and resemble more closely an ordinary slate. Vertically above this tunnel a couple of trenches have

* Ankerite is a carbonate of lime, iron, and magnesia.

been cut in the creek bank, and show a few quartz veins carrying copper pyrites.

The tunnel should certainly be continued for another 100 feet to prove whether the veins of copper-bearing quartz exposed by the main face are continuous. So far only the width of the formation has been indicated by prospecting operations.

The creek turns again to the east a little way further south, and some trenching should be done here to prove whether the lodes cut by the eastern tunnel are of any horizontal extent.

In the south-western corner of the northern section, a trench one chain long has been cut, and a hole put down some 6 feet in the centre of it. The country rock is the clay schist in which green patches of sericite occur, and which is thoroughly impregnated with ankerite. A little quartz is present in veins and small lenses, but no copper accompanies it at this spot.

Near the centre of the southern section, No. 2592, there is a short trench upon a quartz outcrop. The surface cover is considerable, and only a few irregular masses of quartz are visible. There is a small amount of ankerite and both copper and iron pyrites included in the quartz. I noticed also some fragments of included slate, like those in the quartz reef on the Mt. Farrell leases. The outcrop is poorer than that in the north-eastern corner of the section, but seems worth prospecting further.

A few chains to the south-east a trench, 40 feet in length, has been cut. It shows the usual alluvial cover resting upon a dark-coloured wavy slate. There is some quartz in the slate, and on the sides of the trench I saw some slate with veins of siderite and a little iron pyrites. This may come from the end of the trench now filled in by the fallen alluvial from the sides.

On the eastern bank of the creek, south of this latter place, a trench 8 feet long exposes a lode which differs from the copper formation in a striking way. The country rock is the same clay schist, with green sericitic mica on the divisional planes, and carrying a quantity of carbonates, but no silica. The metallic minerals are galena and blende.

The strike measured over the short length exposed is between 10° and 12° east of north. The dip is to the westward. No copper ore at all has been seen at this place.

The ore strikingly resembles that which comes from the vughs in the quartz reefs of the Mt. Farrell Mine.

There is a vein, about 10 inches wide, of ore which carries the metallic minerals (galena and blende) in bands up to an inch in width, and also scattered through the gangue.

A trench, 6 feet deep, was cut at a distance of 60 feet to the southward to test this lode. The sides had partly fallen in and were not visible. On the banks were some pieces of greenish schist carrying veins of quartz and carbonates, with iron and copper pyrites, but no galena.

There is little else done on this area. In the bend of the river, just south of the boundary-line of Section 2593, a trench has been cut in the clay schist, but no ore is visible.

The copper ore of the central section is in itself of very promising appearance; but the quantity available cannot be estimated even roughly until some further prospecting work is done, with a view to proving the length of the lode-formation. The amount of ore carrying native copper cannot be expected to be considerable.

(9)—The White Hawk District.

(*a*)—*The White Hawk Mine.*

The White Hawk property includes the sections numbered 2330-M, 42 acres; 2331-M, 80 acres; and 2332-M, 47 acres. All of these are registered in the name of R. P. Symmons. The 80-acre section contains the workings.

At the centre of central block (No. 2331) is the lode, which was first located by Tom Farrell, and the section was his reward claim. His original workings have been almost completely obliterated by recent prospecting operations. The ore outcrops at the foot of a steep hill of limestone.

A short drive has been put in on a bearing N. 30° W. on the lode. A body of gossan carrying some galena and cerussite (lead carbonate) was met, and a winze put down to a depth of 5 feet on the lode a few feet from the entrance.

At this point the lode seemed to dip east at about 40°, and to strike about 30° west of north. However, very little information could be gathered from the amount of work done. The shape of the ore-body was not clear. On the northern wall of the winze there was a good seam of galena and blende, but metal was absent from the southern wall. The ore gave me the impression of following the joint-planes of the limestone, but no length of lode can be said to have been proved.

Work has been abandoned at this particular spot, and a crosscut has been driven westwards for 141 feet on a bearing of 265°, in the hope of cutting another ore-body.

The first discovered outcrop of ore is situated at the approach to this tunnel. No other metallic mineral than iron pyrites was visible to the west of the lode at the entrance. Galena is said to have been seen while work was proceeding, but I did not find any in the workings.

The drive cut across some cavities in the limestone, which are still visible in the back, and down which the surface drainage brings a quantity of mud.

On the steep hill side which forms the western bank of the White Hawk Creek south of the centre of the section, there are two places where a small amount of galena, associated with zinc-blende, is visible. One is near the top of the hill, and carries some coarse-grained galena with semi-oxidised blende. The strike and dip could not be ascertained. The other occurrence is some 10 feet above the creek level, and shows galena following the joint-planes, and dipping east.

The metal appearing here is, in my opinion, not connected with any other lode yet located in this area.

Near the south boundary-line of this central section a mass of gossan was discovered, which, on being broken into, was found to carry veins of galena. The dip and strike could not be determined accurately, and the possibility of the veins now visible being of a secondary nature is so strong that such observations could hardly be of any value.

A tunnel was started from the creek bank, which is here precipitous, to cut the lode at a depth of 85 feet below the outcrop. The tunnel is on the same level as the other tunnel in the centre of the section, but here the creek is about 25 feet lower. The bearing of the tunnel is 256°, and it has been driven westwards. The limestone traversed dips at 40° to the west. Joint-planes crossing the bedding-planes at the entrance to this tunnel are apt to give a false impression of the structure; but the joints become less pronounced as the surface-rock is left. The limestone shows numerous seams of calcite running with the bedding-planes, and opening out here and there into lenses from a quarter of an inch to half an inch wide, and from half to three-quarters of an inch long.

The tunnel at 40 feet from the entrance met with a body of semi-oxidised ore. There was some crystalline calcite and a mass of gossan carrying galena and cerussite. On the sole of the drive this ore looked very well. A

winze had been started during my visit to the district, and was down 9 feet on ore. A chamber was cut on the southern side of the crosscut, and the winze was following the ore, which at this place is dipping eastwards. The dip varies, becoming much flatter in the bottom of the winze. On both hanging-wall and footwall there is pug carrying fragments of limestone. The ore consists of gossan, carrying blende and galena in bunches through it, and at the bottom of the winze at the time of my visit there were 2 inches of clean galena in the gossanous material, which was dipping east at 35°. The amount of ore was increasing as the workings were carried down, and there appeared to be signs of the lode increasing in width on the southern side of the winze.

The adit was continued past this spot, and when I visited the mine the work of driving westwards was proceeding, at a distance of 123 feet from the entrance.

This tunnel at 80 feet passed through a slide-plane, dipping with the country, and carrying fragments of limestone set in a paste of soft, wet, yellow clay. Some cavities of solution were passed through, similar to those met with in the northern tunnel. Where the drive intersected one of these, at 103 feet from the adit entrance, a mass of gossanous material was met with, which carried galena. This fragment of ore may have been derived from the upper portion of the body of ore cut at 40 feet, and may have rolled down the open cavity to its present position.

Beyond this point the last 20 feet of the tunnel are in very dense limestone, in which the bedding-planes are not decipherable, but which is traversed by a number of very irregular joints. Veins of calcite were present, and in them a little iron pyrites.

The work done at this end of the section has given very inconclusive results. There are two bodies of ore—the surface gossan, some 85 feet above the tunnel; and the ore-body on which the winze is sunk. But the connection between the two, if any exists, has not been proved. The tunnel was being driven in country which, at the time of my visit, showed no indication of the presence of ore. It would therefore seem advisable to follow the surface gossan down, to try and determine the strike and dip. Until more is known about this surface ore it appears to be inadvisable to prospect for it by means of a tunnel.

On the northern boundary of the section in the creek bed a trench has been cut for a few feet. The massive limestone here contains some crystalline calcite, but I could see no trace of any lead ore.

The following assay returns will show that the metallic contents vary considerably. This is no doubt owing to the fact that the lodes are subject to the leaching action of surface waters.

Description of Ore.	Lead.	Silver (per ton).			Zinc.
	per cent.	ozs.	dwts.	grs.	per cent.
Mixed sulphides	41·8	12	5	0	20·5
Gossan	39·2	15	16	5	—
Galena (from gossan)	66·7	11	3	5	—
Galena (from gossan)	49·5	9	13	6	—
Galena (from winze)	39·1	8	15	0	—
Galena	77·2	53	1	16	—
Galena	50·51	27	17	8	—
Galena	60·6	6	7	9	—

(b)—Other Sections on the White Hawk Creek.

On the Section 3367-M, 72 acres, charted in the names of R. P. Symmons and C. R. Lynch, a gossanous cap on the limestone has been found. Some trenching has been done on this outcrop, starting from the small creek that runs southwards to join the main creek near at hand. The trenching shows a number of veinlets of calcite, carrying galena, blende, and copper pyrites. These dip to the west into the limestone, and with the bedding-planes. From the amount of work that had been done, these veinlets gave me the impression of being "droppers" from a lode crossing the bedding-planes. A trench across the formation in an east-and-west direction would afford valuable information.

There is no further work done on this or the other sections charted in the same names.

(10)—The South Murchison Silver and Lead Mining Company, No Liability.

The company holds one section, No. 704-M, of 73 acres, upon which a considerable amount of prospecting has already been done, but hitherto without any successful issue. The object of the work done is to pick up the southward continuation of the Murchison lode. It has been already pointed out that the lode-channel after passing through the porphyroid in the Murchison low-level workings turns and follows a direction only a few degrees west of south. If this strike continues unchanged, the lode-channel should traverse the South Murchison ground,

provided that it is continuous for that distance. The surface cover of vegetation is extremely thick at this place, and the prospecting work has been considerably hampered by its presence.

A lode is said to have been discovered in the river bank just east of the crossing. This formation is said to have carried galena in a gangue of quartz and siderite. At the time of my visit the river was at first too high to see this lode, and later, when the water had subsided, it was deeply covered with silt.

Two lines of trenches are cut at a point near the south boundary-line of the Murchison section, but no definite lodes have so far been located. Some siderite is visible in dark graphitic slate, and with it a little quartz and iron pyrites. This spot is a little to the east of the upper tunnel, and is the strongest evidence I saw on the section of the proximity of a lode likely to contain lead.

The tunnel just mentioned was driven westwards on a bearing of 280°. The country penetrated is a dark-coloured slate, slightly contorted. The tunnel has been carried for a total distance of 107 feet. At 70 feet a drive north was put in some 27 feet, and a further crosscut was driven north-west for 27 feet. The face of this crosscut showed massive quartz, with a little calcite and pyrites. The quartz contains some chlorite. No galena was found in these workings, and they have been abandoned. The company, at the time of my visit, was exploiting the more easterly portion of the section by a low-level tunnel. This starts from the river bank at a point 17 chains N.N.E. of the corner peg on the river bank.

The tunnel is driven west on a bearing of 270°, and had been extended some 160 feet when I visited the property. There is a dark slate at the approach, and then for 150 feet the adit is in a pale-coloured clay schist, not different from the slate except in colour. A few veins of quartz were intersected, carrying some chlorite and associated with calcite. Some of the veins showed a few splashes of blende and galena.

At 150 feet the tunnel passed into a belt of porphyroid, which continues up to the face of the drive.

The company expected to cut the lode by this tunnel with 100 feet of driving, but events have shown their estimate to be much too small. The width of the felsitic rock has not yet been proved at this point, and the surface vegetation is too dense to settle the matter till some further trenching is done. The lode for which the com-

pany is driving is said to be in slate where it was picked up on the river bank. Yet this does not necessarily mean that the lode will continue in slate. The felsitic rock may carry the lode if the fracture persists and crosses over into it from the slate. The upper-level tunnel would appear to be situated just to the westward of the belt of rock said to contain the lode. Had it been 100 feet further to the east much more information might have been obtained. The configuration of the country is less favourable at this point. Still, a site for the lower-level tunel might well have been obtained further west than the one selected.

(11)—The other Sections North of the Murchison River.

On the remaining sections charted on the map accompanying this report practically nothing has been done.

A few cuts have been made along the river bank on Section 2945, registered in the names of R. Green and A. King. Galena is showing in two places in a lode-formation which consists of slate cemented together with carbonate of iron and quartz. This latter occurrence of ore may have some connection with the western lode, which has been located across the river on Thomas' Blocks.

(12)—The Thomas' Blocks Silver Mining Company, No Liability.

This property consists of three sections, viz., 2808-M, 80 acres (lessee, C. W. Thomas); 2850-M, 80 acres (lessee, C. Thomas); and 2918-M, 20 acres (lessee, G. O. Smith).

The main portion of the leases is situated on typical schistose porphyroid, but the slate occupies a large area of the northern section (2808).

Work on the lodes found on these properties has only been in progress for a few months, and thus far nothing is known of the behaviour of the lodes in depth.

There are certainly two lodes on the property, of which the eastern one is the principal.

This main lode, at its outcrop near the northern boundary of Section 2808 in the bend of a creek, showed about 14 inches of banded ore, in which were 4 inches of clean steel-grained galena on the hanging-wall side. The metallic minerals occurring with the galena at the surface were blende, copper pyrites, and iron pyrites. The gangue minerals were quartz, ankerite, and fluorspar.

It was decided to exploit the lode at this spot, and with that object a shaft was sunk at the site of the outcrop first located. This shaft was only just started at the time of my visit, and some difficulty was experienced in keeping it clear of water. There were a few inches of very good ore, consisting of galena and copper pyrites, in the bottom of the shaft. The amount of copper pyrites was not large, but all the ore I examined carried blebs of it.

A point has been chosen about 250 feet further down the creek from which to drive for the lode. Near this approach there was a small vein of a quartzose character, which showed a little galena and blende. In cutting a magazine at this point, the ore was not found to make into body of any size. It is probably an off-shoot from the principal lode.

The first few feet of the tunnel are driven in a southward direction, and it then turns away with a south-westerly bearing to intersect the lode near the shaft sunk from the surface. The tunnel was begun in slate, which gave way within a few feet to a wavy porphyroid. Galena was visible here and there on parting-planes in this rock, which clearly shows the results of alteration by vein-forming solutions. The main lode-channel had not been reached at the time of my visit. When the lode is cut at this point much more information should be afforded. The ore at the surface seemed very free from oxidation on the whole, but a sample from greater depth is needed for comparison.

I have been shown since leaving the field some of the ore from the shaft, which contained a considerable proportion of fahl-ore. The assays made of samples taken from this place gave these returns:—

Silver (per ton).			Lead
ozs.	dwts.		(per cent).
102	18	...	65·4
215	0	...	69·5
201	0	...	—

The discovery of the fahl-ore here seems an excellent sign, and if any quantity of this mineral is commonly associated with the galena of the lode, an ore with a silver content much above the average will result. The increase in the silver content with recent deeper development is notable, for earlier assays of material taken from the outcrop are said to have shown only from 27 to 50 ozs. of silver to the ton.

What would appear to be, in all probability, portions of the same lode as this main one just described outcrop at several points on the slopes which rise gradually from the the river towards Mt. Murchison.

One of these outcrops is situated within the southern section (2850), and close to the south-eastern corner of Section 2808. Very little of the lode was visible at the time of my visit, and the character of the ore seemed a little different from that at the principal workings. It was dense and quartzose, but carrying two bands of galena, making in all about 6 inches of second-class ore. Trenches at intermediate points are necessary to prove definitely whether these southern outcrops are on one and the same line of lode. The trenches would also serve to locate the better shoots of ore for exploitation.

In the south-western corner of the northern section the "western lode" has been exploited by a trench. The lode runs N. 25° W., and is in the same country rock—porphyroid. A trench some 50 feet in length and 8 feet deep has been cut. The metal occurs on a good wall as a narrow seam 1 to 2 inches in width. It is free from non-metallic gangue minerals, but both iron pyrites and blende accompany the galena.

No height of backs can be obtained at this point by tunnelling, and it will be probably found more advantageous to carry a trench on the line of the lode as at present, and to sink on any good shoot of metal that may be met with.

In the north-west corner of the south section there is some gossanous material on the surface which may be derived from this western lode.

(13)—The Tullah Silver and Lead Mining Company, No Liability.

The company is engaged in exploiting a lode which has been discovered on Section 2925-M, 80 acres, registered in the name of E. Pennefather.

The lode has been exposed by some 30 feet of trenching in the creek which traverses the southern portion of the section. At the surface it appears to be of a composite character, consisting of numerous short lenses and bands of galena, blende, and iron pyrites, in a zone of altered felspar porphyry. The width at the surface is about 15 feet, and the strike, as far as could be ascertained, N. 8° W. There is some good milling ore visible in the trenches,

but the lode would need some hand-picking, since the ore follows only certain irregular lines.

A tunnel has been driven, at a depth of 80 feet below this outcrop, in an easterly direction, the bearing being 76°. The country rock driven through is for the most part massive uncrushed felspar porphyry. At 15 feet from the entrance a former river-channel was intersected. The river wash which filled this channel, of which the width in the tunnel is 20 feet, contains boulders of granite, felsite, diabase, and some rounded fragments of lode-material similar to that found in the lode itself.

After passing through this old river bed, a reddish or greenish felspar porphyry was traversed by the adit till a point 210 feet from the entrance was reached. Then the lode-formation was encountered. The tunnel was continued for a total distance of 234 feet from the mouth.

The lode-formation is, in all, 23 feet in width, and dips to the westward at from 80° to 85°. It is a complex lode system, comprising numerous zones separated by divi- sional planes roughly parallel to the outer walls. The gangue is for the most part a greenish sericitic alteration product of the felspar porphyry. Some silica is present especially on the footwall side. Much of this silica is of earlier date than the impregnation by the lead-bearing solutions.

The footwall country is a chloritized felsite, which is free from galena, but ribbed with vertical veinlets of quartz. Part of it, too, is hardened by an intimate infil- tration of silica, till the rock becomes practically a jasper or chert. This phenomenon is merely a phase of the forma- tion of the siliceous veinlets so common throughout the district, and with which no other metallic mineral than iron pyrites is associated.

The felspar porphyry, once fractured and cemented together with the silica veinlets, has been refractured, and the metallic contents have been introduced.

The metallic minerals present are galena, blende, and copper pyrites; and with them there is present a little siderite. This latter gangue mineral, so characteristic of the field generally, is present in appreciable amounts only where the larger pockets of ore are found. The zone of country which has been altered by the vein-forming solu- tions is notable for the development of sericitic mica rather than the carbonate minerals.

The galena and other metallic ores are found in bunches and pockets, and along all the cross-heads in this com- pound lode-formation. The zone which carries the most

ore is the central portion of the lode. This is also the softest, for the development of sericite and carbonates is most marked there. Some of the galena is in an extremely fine state of division, and the lode is so minutely impregnated with it in this central zone that any broken fragment of ore shows the fine-grained metal throughout.

With a view to proving the lode, there was started during my visit to the field a northward drive, which had been carried for some 28 feet along the footwall. The lode here was hard and poor. Since my return from Mt. Farrell the drive has been carried another 100 feet northwards, but the driving has been continued a little to the west in the central and softer portion of the lode-formation. The results are reported to be much more encouraging, and some ore carrying a fair proportion of fahl-ore has been obtained.

It will probably be wisest for the company to follow the lode on the present level and sink on the better shoots of metal met with, rather than to drive a low-level adit, which would need to be a very long one, in order to obtain any considerable height of backs. A survey made by the company shows that, with 925 feet of driving, some 320 feet of backs are obtainable.

The following are the results of assays made from ore from this mine since 6th January, 1908:—

Silver (per ton). ozs. dwts. grs.		Lead (per cent.).
13 4 14	...	77·1
32 0 6	...	77·6
47 17 3	...	73·0
305 16 0	...	77·6
222 10 0	...	74·7
429 18 16	...	74·5

The latter three samples contained fahl-ore. The variation in the silver content in the others is perhaps due to the proximity to the surface. Much water was encountered during the driving, when the lode-formation was met, and the circulation of surface waters may cause a partial leaching of the silver contents.

(14)—M. Donoghue's Sections, Nos. 2863 and 2864.

These two sections are of 80 acres each, and are on the line of what is probably the major fracture in this area.

The main lode outcrop, now being prospected on Thomas' Blocks, is the most northerly outcrop on this line

of lode. As already stated, some further intermediate trenches are required before these different outcrops can be regarded with certainty as being on one continuous lode. Still, the probability that they are on the one lode is very great. The line of the lode seems on the map to bend away a little towards the east; but it is to be remembered that the country is rising here towards the heights of Mt. Murchison, and the dip of the lode at Thomas' Blocks has been shown to be to the westward.

Just outside the south-eastern corner of Section 2850, of the Thomas' Blocks lease, there is an outcrop of the lode. The country rock is still the schistose type of the porphyry. Galena is visible at the surface, and some iron pyrites in a siliceous lode.

Still further south there is an outcrop in the creek, on which some work has been done, and in which a very promising lode has been disclosed. It is a complex formation, from 14 to 18 inches in width, consisting of second-class ore with narrow veins half an inch wide of clean galena on the walls. With the galena are its associates, characteristic of the lodes on the field, viz., blende and both copper and iron pyrites.

The country rock is here no longer schistose, but massive quartz-felspar-porphyry. The hanging-wall is but little altered, and is pink; but the footwall is greenish, and carries streaks of metal in the sericitized zone. This occurrence is 720 feet, by aneroid measurement, above the river.

Still further south, and a chain inside the boundary of Section 2864, is an outcrop showing disseminated galena, blende, and iron pyrites over a lode 18 inches wide in the quartz-porphyry. This spot is 875 feet above the river.

Further up the hill still, and 960 feet above the river, there is in the creek a greenish lode some 8 inches wide, carrying pyrites and galena.

The south-western portion of the southern section contains two occurrences of ore, which have had a little trenching done on them. The western occurrence shows iron pyrites, blende, and galena, in a green lode-matter resulting from the alteration of the felspar-porphyry, which is here schistose.

South-east of this occurrence is a somewhat similar one. The trench shows a greenish quartzose lode, of which the bearing is about N. 35° W. The lode carries galena, blende, and pyrites. The country is the massive type of felspar porphyry.

The lodes on this section are well worth further prospecting, especially the eastern one, which I think to be probably the southward continuation of the "main lode" on Thomas' Blocks. The prospecting now being carried out on the latter property will no doubt afford valuable information, which will be of benefit to the future prospecting of this lode. The surface configuration will enable the lode to be worked at several levels by means of short adits.

(15)—The Sections in the Sterling River Valley.

To the west of the Thomas' Blocks and Donoghue's sections are a line of sections situated on the low ground leading down to the Sterling River. These sections—numbered 2861-M, 20 acres; 2837-M, 80 acres; and 2862-M, 68 acres—stand in the names of J. H. Finlay and M. Donoghue.

The western portion of the area consists mainly of slate, but in which there are some parallel narrow bands of porphyroid. The outcrops are few, and I could not determine whether the porphyroid was intrusive or whether thin sheets of lava were interbedded with the slates.

There is a long quartz reef traceable right through these sections from end to end, which has a trend slightly to the east of north.

The only work done on these sections has been carried out on this quartz body.

The outcrop of quartz has been cut through by a trench at a point just south of the boundary-line, between Sections 2837 and 2862. The quartz is some 15 feet across at this point, and has a westerly dip. There is a little iron pyrites present in the quartz, and with it some copper pyrites. On the hanging-wall side of the reef in the slate there is a vein of galena half an inch in width; and on the footwall side there is a gossanous admixture of quartz limonite and iron carbonate carrying a little galena.

An assay of the ore from this spot is said to have shown the presence of 11 ozs. of silver to the ton.

A few chains to the northward the quartz shows only iron pyrites, and no trace of lead ore.

Following the outcrop northward it disappears under the button-grass, but again reappears in the same line. Some trenches have been cut across it in Section 2861, and just outside the northern boundary of this section, but only iron pyrites was found in the quartz.

This quartz reef seems, therefore, barren, as far as galena contents go, and to resemble in many ways the quartz reef in the Mt. Farrell sections. The one spot at which the galena has been found appears to me a place where a later fracturing has in part coincided with the original fracture, enabling the galena to be introduced alongside the quartz.

(16)—Other Sections South of the Murchison River.

On the north side of the Tullah property, and between it and the river, lie two sections—No. 2830-M, 80 acres, registered in the name of C. A. J. Collins; and No. 2911-M, 79 acres, in the name of C. Thomas.

The former of these, No. 2830, carries only one trench in the centre of the section. The rock exposed is porphyroid, impregnated with galena, blende, and iron pyrites. Too little work has been done to form any estimate of the value of the lode.

On Section 2911 there is a little work done on the north-western corner, high on the slopes of Little Farrell. In the crushed conglomerate, 500 feet above the river, a small body of quartz has been disclosed, which carries some very coarse clean copper pyrites. The bulk of ore proved is so far very small, but it is so rich in copper pyrites that further work at the spot might well be carried on.

A little higher up the hill there is some massive haematite, which merges gradually into the crushed conglomerate, which it has in part quite replaced. I did not see any sign of any copper ores in association with the iron oxide.

On Section 2921-M, 37 acres, in the name of E. Goldsmith, no work at all has been done, and no lode discovered.

To the east of Donoghue's sections lies an 80-acre section, No. 2940, standing in the name of H. J. Kelly. The country rock is massive quartz porphyry on the western side, and this merges into a medium-grained granite on the east.

A trench has been cut in the granitic rock, and exposes a green, altered zone, which carries some iron pyrites.

The same zone has been cut by a trench a little further north, outside the section, and some veins of quartz, carrying iron pyrites, are exposed. I saw no indication of galena in this area.

(17)—The Sections on the Northern Slopes of Mt. Murchison.

(*a*)—*The Two* 40-*acre Sections*, 2865 *and* 2866.

These two sections are registered in the names of R. P. Symmons and J. J. Rice.

On the southern section, 2865, on the track running through the section, a small excavation has been made in the outcrop of a lead lode. The country rock is granitic but the galena occurs in a remarkable gangue of quartz, barytes, calcite, and actinolite. Reference has been made to this lode type in an earlier portion of this report.* Some coarse cubical galena was visible at the top of the cut, but the lode seems to pinch towards the bottom of the excavation, and the galena is largely replaced by iron pyrites. These workings are 1000 feet above the Murchison River.

On the adjoining section, 2866, a shot has been put in the rock over the track in the northern portion of the section. A chloritized lode-stuff is exposed, carrying a few splashes of copper pyrites. This ore resembles the copper ore visible at several points on the Osborne Blocks and other sections situated along the Murchison River.

The bulk of ore does not seem to be great, and the copper content too low at this place for the deposit to be of value, unless future operations produce a marked improvement.

(*b*)—*The Two* 80-*acre Sections*, 3070 *and* 3071.

These two sections, known as the "Sterling" sections, are registered in the name of W. Woolven. They are situated on the northern slopes of Mt. Murchison, and in altitude from 1300 feet above the river on the northern boundary, to 1440 feet on the eastern boundary of the southern section. The country rock is on the eastern side massive, uncrushed felspar porphyry, and on the western the typical crushed porphyroid.

Near the centre of the northern section there is an outcrop of massive hematite at the surface, and a tunnel has been driven some 30 feet below to cut the lode. The tunnel runs for 40 feet on a bearing of 124°, and cuts the body of hematite, but does not penetrate it. On the exposed face I saw a little copper carbonate and copper sulphate. Galena is said to have been seen while the tunnel was being driven, but I could not find any trace

* See p. 40.

of it remaining. It is said that the black gossanous material on the border of the mass contains native copper. No specimen which I examined carried the mineral. The country rock is porphyroid.

All the ironstone seen was apparently well above the water-level, and the workings are consequently too shallow to give an idea of the proportion of copper ore associated with the hematite. The configuration of the country is rather unfavourable for the driving of a lower-level tunnel. It would be better in future prospecting to sink on the lode.

On the southern section the porphyroid carries a few stains of copper carbonate, but outcrops of the rock are few, and no further signs of the presence of a lode were detected.

(*c*)—*The Barytes Lode.*

Situated between Section 2865 and the Murchison River, and at a height of from 600 to 700 feet above the river, there is a strong vein of barytes.

This is exposed at the surface for a length of 5 chains. Its width is at least 4 feet at the southern end of the outcrop, but no work has been done elsewhere, and I cannot say if this is the average width.

The barytes is crystalline, and white or transparent at first sight. Careful examination, however, shows that it is flecked throughout with minute specks of galena.

Several prospectors enquired of me whether the barytes cap might not be a sign of a massive galena lode in depth. They seemed to have the impression that there were known cases of the variation of lode contents of the type mentioned. If any such cases exist they are unknown to me.

It is true that in the case of barytic lead-veins* the progress of weathering may after a long interval of time produce a gossan relatively rich in barytes. This is because of the insolubility of barytes. But in the present case the vein is a solid one, consisting almost entirely of massive barytes, and not a honeycombed gossan; and there is no justification for the belief that the mineral character will alter materially.

If the occurrence is to prove of commercial value it will be as a source of the mineral barytes itself. Barytes is used mainly in the manufacture of paint as a substitute for white lead or zinc oxide, and to a less degree for

* Described on p. 49 of this report.

weighting paper and for the preparation of the oxide of barium.

For such purposes it is necessary to, first of all, free the barytes from its associated impurities. In this case no great difficulty would be encountered; for, apart from the small galena content, I did not observe any other mineral present, and the purity of the colour indicates its freedom from iron.

The price fluctuates slightly, but the average value for the crude product, delivered at a grinding-mill, may be reckoned at between 16 and 20 shillings per short ton.

When finished for the market, the mineral is worth as much as £4 per ton.

Until better facilities for the transport are available, I doubt if the value of the mineral is sufficient to justify the exploitation of the lode.

(18)—The Eastern Sections on the Murchison River.

(*a*)—*The Sections known as "The Osborne Copper Blocks."*

The track which follows the northern bank of the Murchison River towards the south-east traverses a number of sections, of which only two are at present taken up. These are Nos. 2144-M, 80 acres; and 2145-M, 80 acres—both of which stand in the name of C. Madden. The greater portion of both these sections consists at the surface of chloritized quartz felsite, but the conglomerate encroaches upon the borders of each section.

On the northern side of the river, near the centre of Section 2144, there is a massive outcrop of hematite. The schistose green quartz felsite has been, by silicification, converted into a grey quartzite in the immediate neighbourhood of the hematite.

A few distinct quartz veins are to be seen, and these carry both iron and copper pyrites; and besides these actual veins, the green quartz-felsite is irregularly impregnated with iron and copper pyrites and a little galena. Very little prospecting has been done on this outcrop, which certainly merits further attention. Two approaches of a few yards each have been cut from the west and north-west, as if to cut the hematite body; but in neither case has the work been carried far enough to afford much information.

Below this point, on the track, the quartz felsite again shows an impregnation with copper pyrites.

This section seems well worthy of more work being carried out upon it. Very little has ever been attempted, and the vegetation is so thick that prospecting cannot be carried out without trenching.

In the adjoining section (2145) at the southern corner of the portion which lies on the northern side of the Murchison River, and right on the water's edge, there is a further outcrop of metal. A zone of the quartz felsite about 30 feet in width is impregnated with copper pyrites and bornite. The occurrence has had very little done on it, and the surface only has been exposed here and there. As far as I could see, there are no definite walls to the deposit. Some joint-planes are visible, but these seem of later date than the impregnation with metal, for the ore does not follow the divisional planes at all.

This formation should certainly be vigorously prospected.

A very similar occurrence of quartz felsite which has been impregnated with copper pyrites is situated nearly a mile south of this spot, on Section 4440, where the track traverses the centre of the section. Here, too, only the surface has been broken from the outcrop.

On the southern side of the river, and in Section 2145, some further workings are situated. Some copper and iron pyrites are visible in the quartz felsite, and a short tunnel has been driven westwards at a point 75 feet above the river. The tunnel only runs in some 15 feet; and a short drive, 10 feet in length, runs southwards from the end.

About 20 feet higher up the hill the quartz felsite is replaced by actinolite rock. A trench shows a few colours of iron pyrites and hematite along joint-planes, and in thin seams in the rock. The prospects at this point do not seem very encouraging.

(*b*)—*Foy's Lode.*

During my visit to the field a discovery was made by R. Foy of a lode crossing the Murchison River in the north-western corner of Section No. 24-M.

There are two distinct veins on the eastern side of the river, separated by a distance of 5 feet. The eastern one carries some good coarse galena associated with blende, iron pyrites, and copper pyrites in a gangue, which is mainly silica. A few fragments of bleached and kaolinized country rock are included in the lode. This vein is about 8 inches wide where it was first picked up, at a

height of 25 feet above the river, and widens to a foot or more at the water's edge.

The eastern wall (footwall) is the green quartz-felsite which has been sericitized. The hanging-wall is impregnated with very finely divided galena and thin veinlets of quartz and pyrites. The dip is towards the west, at about 75°; and the strike, measured across the river to the outcrop on the other side, is N. 21° W.

The western vein is smaller—4 inches wide—and dips to the west at angles which vary a good deal over the small length of lode visible. It carries a little less metal and more quartz. Blende and copper pyrites are present with the galena. Across the river at the water's edge both veins could be seen; but they are here hard and quartzose. The two veins unite about 12 feet from the water, and at the junction a pocket of good galena occurs. A little blende, copper pyrites, and fahl-ore accompany the galena at this point.

Traced beyond the intersection the ore becomes once more hard and dense, and narrows down to a width of 6 inches.

The pinching of the lode may be only a local feature, but the prospectors will probably find it more profitable to exploit, first of all, the main vein on the eastern bank of the river. As a preliminary to future operations, I should advise trenching on the eastern bank.

The lode being known to persist on the western bank, it should be eventually followed there; and the exploitation at this point will be easy, since the bank rises almost precipitously from the river.

The brecciated character of the lode-stuff indicates the fact that the lode is the result of the filling of a well-defined fissure, rather than an impregnation of the country rock.

(*c*)—*Kittson's Workings.*

Following the track southwards from Foy's lode a small outcrop of hematite is met at a point just outside the western boundary-line of Section 24-M. The country rock is quartz felsite, but no copper is found here in association with the iron.

The track follows the river bank, and no striking difference is noticeable between the country rock here and that further north until a belt of crushed conglomerate is met with, similar to that which forms the western slopes of Little Farrell, in Section 2911.

Beyond this the igneous rocks occur again, and in them the old workings of H. E. Kittson are situated. The section, No. 2829-M, 80 acres, is now registered in the name of L. Jolly.

The workings are in the northern portion of the section, and on the south side of the river close to the cage.

Close to the landing-place of the cage, and only just above the river level, an excavation has been made in the steep bank, which shows a band of quartz porphyry impregnated with iron pyrites, copper pyrites, native bismuth, and a complex mineral termed lillianite. Some oxidised copper ores are also present. Some very rich silver ores are said to have been derived from this locality; but in what form the silver existed I cannot say. The veins seemed to run in all directions, and all the mineral exposed was much weathered and discoloured by limonite.

About 150 feet to the south-east, and 80 feet above the river, another zone is opened up, some 20 feet wide, and through it a number of small veins run. The veins are vertical, but their strike is very variable. These veins carry a little iron and copper pyrites, together with some specular iron ore.

Below this outcrop, and 30 feet above the river, a tunnel was started in granite, but abandoned when 15 feet of driving had been done.

The mouth of the tunnel shows a greenish altered zone in the granite, which appears to dip northwards. If the work is persevered with, this tunnel should prove the lode-formation in depth. The surface workings are too much affected by weathering to give much information at the present time. I could find no sign on the surface of a main fissure, nor could I trace any connection between the ore exposed in the two sets of workings.

No work at all was being done at the time of my visit to the locality, and there were no signs of any recent attempt to prove the property.

(19)—The Sections on the Pieman River.

The track to Rosebery from Mt. Farrell follows the Pieman River round the base of Mt. Black, and from the Murchison River on the western side of the Mt. Farrell township to the railway bridge over the Pieman the country rock traversed is wholly the felspar porphyry.

The river alluvial overlaps the base of the higher ground, and the present river has cut its way down through this gravel.

The felspar porphyry is very similar in appearance to the corresponding rocks further east. It is on the whole schistose, but the degree of schistosity varies between wide limits.

The region is traversed by a number of minor, and one major, fractures, at a distance of about 2½ miles from the junction of the Mackintosh and Murchison Rivers.

Only one section on the area is at present taken up, viz., No. 2382, 40 acres, which is registered in the names of G. A. Gabbedy and W. M. Black. It is on this property that the mine known as the Langdon is situated.

The lode was first discovered at the point where Innes' track crosses it by a prospecting party, who worked northwards from Rosebery along the felspar porphyry belt. It exhibits a marked peculiarity of structure, in that the strike is due east-and-west. The dip is northward.

A tunnel has been driven southwards from a point 30 feet below the outcrop. The bearing is 147°, and at 30 feet it passed through the lode.

It is said to have been driven another 30 feet on the same bearing, but the portion of the drive past the lode was blocked by waste. The tunnel was carried past the lode, for the reason that the values had so materially decreased in depth that it was thought the lode was still ahead.

I am informed that the upper portion of the workings produced some very good galena, of which about 40 tons was taken to the smelters. At the time of my visit all this material had been stoped out right to the surface. A few specimens lying on the tip showed good coarse galena with resinous-looking blende.

There is a drive on the lode from the adit for 30 feet in an easterly direction. The back of the drive shows that the ore-body has pinched to a width of only a few inches, and, in fact, can hardly be traced at the intersection of the drive and tunnel. About 10 feet from the end of the drive there are 6 inches of ore, consisting of coarse galena mingled with resin blende. But on the whole the galena seems to have given place to resin and ruby blende.

The contraction of the ore-body and the impoverishment in the lead content have no doubt led to the abandonment of active work, and the mine has been idle for 12 months.

It is regrettable that while work was in progress no winze was put down on the lode to prospect it in depth. The pinching of the lode may be only a local feature, and

after such a promising outcrop it is a pity not to carry the work down beyond the very shallow-level tunnel.

There have been several trenches cut on the western continuation of the lode outcrop, but they show only zinc-blende with traces of galena in veins through a mineralized zone. These trenches extend to the western boundary of the section, and have not indicated sufficient values to justify further prospecting at a depth.

The country rock is a felspar porphyry, which is slightly altered near the lodes, probably by the development of sericite. Numerous veinlets of silica are to be seen in the country rock near the lode, and these veinlets seem to have a tendency to run in an east-and-west direction. The country rock is also indurated here and there by an intimate impregnation by silica, till it resembles a chert.

Higher up the hillside, some 250 feet along the track, there is a little work done on a gossanous capping. A few shots have been put in, and a complex lode-formation is disclosed. It is 6 or 7 feet in width, and carries a number of small veins up to 3 inches in width of zinc-blende, and very occasional splashes of galena. The blende has by weathering acquired a coating of limonite, but the undecomposed material is dull yellow, and has been mistaken for carbonate of iron.

Too little of the lode was exposed to determine the dip. The strike seemed to be a little north of east. The country rock is similar to that of the Langdon Mine.

There has been some trenching on the adjoining section, 2524, now vacant.

In one of the trenches below the track on the eastern boundary a small vein, some 4 to 6 inches in width, is exposed. It strikes N. 55° W., and dips to the north-east at from 80° to 85°. The lode contents are blende and a little galena in a band of silicified felspar porphyry.

A trench running a little east of north has been put down to cut the continuation of this lode, but without success.

There is also some trenching on the line of the Langdon lode, and in one trench a lode a foot wide, carrying some veins of tarnished blende and a little galena, is visible. A winze, full of water at the time of my visit, had been put down in the bottom of the trench, so I could not see the lode at that point.

The veins that have been located in this section seem to carry blende rather than galena, and work in the area has been altogether abandoned.

VII.—CONCLUSION.

Summing up, the writer may express the opinion that there is a well-assured future before the central area of the Mt. Farrell mining field.

The centre of future operations will, as far as can yet be foretold, be located round the North Mt. Farrell and Mackintosh leases. These appear to possess, in a greater measure than any others, the attributes which justify the outlay of capital for the development of the mines and the treatment of the ore.

One of these properties—the Mackintosh—is at present practically untouched. Yet the ore proved at the surface gives every indication of permanency in depth, and the length of the lode compares favourably with that of the lodes on any other lease in the field.

The ore-bodies on the two above mentioned properties contain a bulk of second-grade ore, which will, with efficient milling plants, ensure profitable returns for several years at least.

And there are several other properties to the southward which can show a fair amount of milling ore. No one of these, taken by itself, can yet be said to have justified the erection of a concentrating mill. Still, were a customs mill located in the district, there are several mines, now inactive, which would probably contribute second-class ore. The returns from this second-class ore would at all events assist financially towards the development of the properties; and during the mining of the second-class ore the contributing mines might well improve, or show an ever-increasing bulk of the milling ore.

The tendency has been thus far for the management of those mines which are in the earlier stages of development to expect highly payable lodes of first-class ore, rather than lodes of which the greater proportion, at least, is second-class ore. This being so, the work of development has in some cases been abandoned at once where first-class metal is not encountered. The lessons taught by the development of the North Mt. Farrell Mine should be remembered; for not only does the ore-body vary very considerably from point to point, but in one case the main lode (No. 3 lode) was passed through without being recognised.

The attitude assumed with regard to the presence of first-class ore has resulted in undue prominence being given to the assay returns from picked specimens of ore. Few, if any, assays of samples properly taken are obtainable; and the value of assays of specimens is, of course,

purely qualitative. The presence of fahl-ore with the galena, will, in the majority of cases, ensure a high return of silver. Yet, in the mines which have been opened up to any extent, the proportion of fahl-ore to galena is small.

The recent developments at the southern end of the field seem to point to its presence in larger proportions there, but this cannot be regarded as certain until the lodes are opened up more extensively.

The southern end of the field is undoubtedly expanding, and much will depend upon the work of the next few months on the Tullah Mine and Thomas' Blocks. Every successful development on these properties will stimulate further prospecting in this direction.

The northern end of the field has been seriously hampered by the difficulties of transport, and the lodes which have been located are almost entirely undeveloped, notwithstanding the fact that they were the first discovered in the district.

There is one strip of country which has thus far quite escaped the attention of prospectors—that between the Tullibardine lease and the Farrell Blocks, and lying on the western side of the Mackintosh River. It has been indicated in this report that it is probable that the Tullibardine lode lies on the main fracture-line of the central and northern part of the field, the strike-line of which has been bent a little to the eastward by the disturbance which produced the fault that traverses Section No. 2796.

The area on the Murchison River, eastward of the gorge cut through Mt. Farrell, is well worthy of more systematic prospecting. The recent discovery of a lead lode in that district should assist in stimulating prospecting activity.

This report embodies the field work which was carried out during the months of September, October, and November of 1907.

In conclusion, I wish to express my appreciation of the assistance afforded to me during my examination of the field and the preparation of this report by all those who are, in different capacities, interested in the field. The number of these to whom I am indebted is so large that I trust I may be permitted to make this general acknowledgment of thanks.

L. K. WARD,

Assistant Government Geologist.

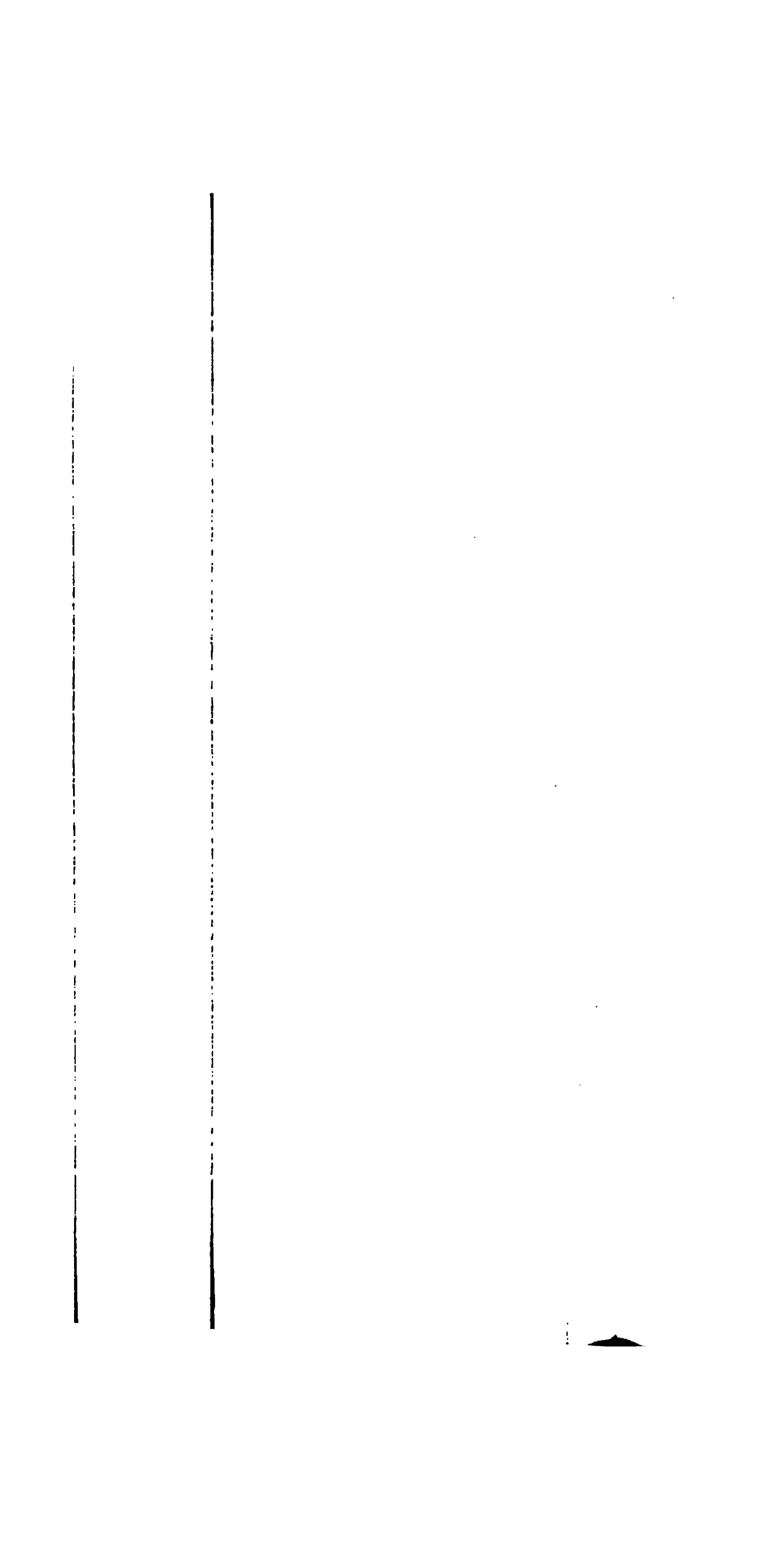
Launceston, 15th February, 1908.

KEY TO PLATE II.

The Mineral Sections now taken up.

Number of Section.	Acres.	Lessee.
		White Hawk District.
2330-M	42	R. P. Symmons. (The White Hawk.)
2331-M	80	
2332-M	47	
3367-M	72	R. P. Symmons and C. R. Lynch.
3368-M	40	
3369-M	37	
		The Area North of Mt. Farrell.
2592-M	80	J. McPhee. (The Tullibardine.)
2593-M	80	
2058-M	80	
		The Area on the Western Slopes of Mt. Farrell.
2873-M	80	C. R. Lynch.
2892-M	40	G. E. Butler.
2796-M	80	G. E. Butler. (Formerly Metropolitan.)
2909-M	80	W. Innes.
2905-M	80	J. Geddes.
2397-M	79	E. Goldsmith. (Farrell Blocks.)
2820-M	80	A. E. Goldsmith.
2983-M	80	A. E. Goldsmith.
3010-M	80	D. Powell.
3223-93M	80	Macintosh Copper & Gold Mining Co., N.L
3221-93M	80	
4116-93M	68	North Mt. Farrell Mining Co., N.L.
3262-93M	76	
1867-93M	80	
2351-M	75	
2722-M	40	
1074-M	20	
292-W	10	
82-W	4	
2409-93M	80	Mt. Farrell Mining Co., N.L.
2410-93M	80	
2656-M	10	
2815-M	80	M. L. Maconnochie.
1980-M	80	(Formerly Central Farrell.)
3263-93M	60	Murchison River Mining Association, N.L.
1286-M	5	
1075-M	79	E. T. Midwood (Murchison Extended). (Formerly North Murchison.)
2777-M	80	H. J. Kelly.

Number of Section.	Acres.	Lessee.
2891-M	40	M. J. Thornton.
2981-M	75	C. H. F. Shearn.
704-M	73	South Murchison Silver-Lead Mining (N.L.
2945-M	40	R. Green and A. King.
2946-M	40	
The Sections South of the Murchison River.		
2921-M	37	E. Goldsmith.
2830-M	80	C. A. J. Collins.
2911-M	79	C. Thomas.
2808-M	80	C. W. Thomas.
2850-M	80	C. Thomas. (Thomas' Blocks.)
2918-M	20	G. O. Smith.
2925-M	80	E. Pennefather. (Tullah Silver-L Mining Co., N.L.)
2863-M	80	M. Donoghue.
2864-M	80	
2861-M	20	J. H. Finlay and M. Donoghue.
2837-M	80	
2862-M	68	
2940-M	80	H. J. Kelly.
3071-M	80	W. Woolven. (Formerly Sterling.)
3070-M	80	
2865-M	40	R. P. Symmons and J. J. Rice.
2866-M	40	
Eastern Sections on the Murchison River.		
2144-M	80	C. Madden.
2145-M	80	
2829-M	80	L. Jolly.
Sections on the Pieman River.		
2382-M	40	W. M. Black and G. A. Gabbe (Formerly Langdon.)



THE LISLE GOLDFIELD.

[Five Plates.]

I.—INTRODUCTION.

THE small township of Lisle is situate by road 7 miles south-west of the Lisle-road station on the Launceston to Scottsdale railway, and 8 miles due north from Patersonia. Cart traffic is mostly by way of Lisle-road, but the mail-horse route is *viâ* Patersonia. The few homesteads and surviving cottages are on the floor and basal slopes of a broad valley, about 2 miles in length, running in a north and south direction, and forming a triangular or sub-elliptical area between the Main and Bessell's Creeks. The confluence of these two creeks takes place at the northern end of the valley, where the hills close and a rocky gorge is formed through which the Lisle Creek flows northward to join the Little Forester River.

About a couple of dozen men are now occupied in sluicing the gravels for gold. The sawmill, which supplies timber for the builders' use in town, gives employment to several men. These, with the inhabitants of a few homesteads, make up the present population of the valley. Scrub has grown up again on the flat land which many years ago was cleared when mining was in full swing in the valley. Some of the purchased land in the centre of the valley and on the eastern slopes is cleared, but the rest is closely timbered for the most part. Tall gum forest clothes the hill sides, with a thick undergrowth of dogwood, musk, and cathead fern. The soil in the valley and on the lower slopes is clayey with a granitic bottom, and the land is well suited for grazing purposes. Fruit also does well. Mr. Furlonge has an orchard which produces apples admired in the London market.

The goldfield and the land surrounding it have been withdrawn from selection for many years, but 1400 acres in the south-western portion of the reserve have recently been proclaimed available for purchase, though in deference to indications of renewed mining activity on the field no sales have as yet been sanctioned.

II.---PREVIOUS LITERATURE.

The Government has caused two official examinations of the Lisle field to be made previously to the present one. The first report was by Mr. G. Thureau, Geologist to the Government of Tasmania, and was published as a House of Assembly Paper (No. 46), in 1882. The following extract will serve to show the conclusions then arrived at:—

"At the junction of the metamorphic schists with the syenitic granites, not only are there narrow quartz veins accompanied by granitoid vein matter, mica, hornblende, &c., but distinct, though small, veins of this granitoid rock protrude and traverse the schists for a considerable distance from the main body . . . .

"Bearing in mind that the whole of the granitoid formations are traversed by attenuated quartz veins charged with very fine gold, it may be inferred that if any vein matrices with coarse gold exist the probability is that they occur at or near the points of contact of the granitoid with the metamorphic or other schists on the Lisle Divide and in the eastern foothills of Mt. Arthur."

The second Government inspection was by Mr. A. Montgomery, M.A., who reported on certain portions of the Lisle goldfield, on 13th September, 1894. This report was not printed. The following is extracted from it:—

"The Lisle workings lie in a somewhat wide valley, which contracts to a gorge lower down the creek. The bottom of the valley has been worked for some 500 or 600 feet in width, from which it would appear that the auriferous material could not have been confined to one narrow lead, but must have spread over some distance. Round the edges of the flatter ground at the foot of the slopes of the surrounding hills there are large terraces of alluvial material, some of which has been successfully worked. It seems rather likely that at one time the detritus from the surrounding slopes was brought down into the flat part of the valley faster than it could be discharged through the gorge at the outlet, and consequently large accumulations took place, especially at the bottom of the hill slopes. In one claim I noticed traces of the former presence of still water, there being a layer of finely laminated clay and sand lying horizontally upon the bottom gravel, and in the clay were numerous lignitic impressions of leaves . . . The gold from this field is very fine in grain, nuggets

being quite rare, and is said to be very seldom found with quartz attached to it. The wash is of a clayey nature in the terraces, with not a great deal of stone through it. The stones are but little waterworn, and consist of metamorphic sandstones from the surrounding hills, chalcedony from veins in the granite, and only a little quartz that seems likely to have been derived from reefs. In parts we find veins and patches of quartz wash, but on the whole it does not seem very plentiful. In some of the claims towards the head of the valley there is much less clay than in the terraces near the township, and faces of 6 to 15 feet in depth of coarse sandstone gravel are seen in the workings. In these the stones are more waterworn, and the wash appears to be richer in gold. . . . The veins on Titmus and Dodgshun's sections are said by some to be the only ones yet found carrying gold on the Lisle field, but I have also been informed that similar ones were not infrequently met with in the bedrock by the alluvial diggers. It seems very possible that much of the gold in the valley has been derived from similar veins, but I am more inclined to think that the sandstone country, and particularly the belt along the contact between the granite and the sandstone, will in time prove to be the source of the gold."

Mr. Charles Bessell (the Bessell Bros. were the discoverers of Lisle) wrote a report for a proposed hydraulic company in 1894, and the following extracts are taken from it:—

"Payable Ground Available.—This, I may say, is practically unlimited. In my opinion there are three distinct deposits of gold in the field, and it is also my opinion the sources are all within the Lisle valley, and have yet to be found. However, I can, I think, safely state that there are 500 acres averaging 12 feet in depth. This ground may be equally divided into old ground or ground that has been worked in the early days, and new or sound ground; part of this is not rich enough to pay by the slow process of pick and shovel. As to the old ground, in my opinion this would pay well, for personally I prefer to work good old ground than new poor ground. As to the probable yield per cubic yard, this is rather a difficult question to deal with, as in some places the gold is distributed through the ground from the surface to the bottom, while in others it is confined to the wash on the bottom, which varies from 1 foot to 5 or 6 feet. I have worked ground here with a payable prospect from the

surface to the bottom 15 feet in depth. I have also worked ground the same depth with no gold except in the bottom 2 feet with equally payable results. However, I believe I shall be well within the mark if I say the whole of the ground referred to will average from 4 to 6 grs. to the cubic yard—this is independent of rich patches, which will probably go several pennyweights to the yard, and I feel quite confident that many of these will be met with as work proceeds. I may state that there are many indications of false bottoms existing on the terraces; in fact, Cashman and party are at present working under 2 feet of false bottom, and again, it can be seen where I am now working at the camp, but how far it extends into the hill has to be proved. With reference to the quantity of gold obtained here I have heard many estimates, but being connected with its discovery 15 years ago, and having an object in endeavouring to ascertain the yield for the first years, as the Government of the day offered great inducement to prospectors in the shape of a large reward for the discovery of a payable goldfield, during the first year I obtained certificates from some of the gold-buyers that they had bought about 15,000 ozs. This, however, does not represent the total yield, and I have heard that Mr. Bernard Shaw, who was then Commissioner of Mines, estimated that not one-third of the gold won was sold in the country. In this I quite agree with him, as a very large number of the 2500 miners then on the field came from Victoria, and I know many of them took the gold there periodically. It must also be remembered that during the first year the men had all their dead work to do in opening up their claims, consequently were not getting gold the whole time, and one of the buyers referred to told me he had bought more gold the first half of the third year than he did during the whole of the first year. Taking all this into consideration, I believe I shall be near the mark by estimating the total yield to be 250,000 ozs., or in round numbers £1,000,000 worth; but I have heard some estimate the yield to be considerably over that amount. With reference to the yield of individual claims, this is a difficult matter to get at, as miners are generally very reticient on this subject. However, I have heard the yield of some of the claims from reliable authority. The best yield I have heard of was from Clare Brothers, who obtained over 1000 ozs. from two men's ground. This claim was on Bessell's Creek, and may be taken as an average. Donnelly and party, I am told, got consider-

ably over 1000 ozs. from their claim. There were several good claims on the terraces, the wash-dirt varying in thickness from 1 foot to 4 feet., and yielding from 5 dwts. to over an ounce to the load. The first claim in which I was interested yielded nearly 500 ozs. from four men's ground. This claim was on Bessell's Creek*, and may be taken as an average of all the claims on it for a distance of nearly 2 miles in length. Shillady and party have, I believe, won over 2000 ozs. from their claims. Cashman and party are reported to have had very good results all through, and I am informed that the last six months' washing resulted in nearly £200 per man."

In 1899 the Lisle Dredging Company was formed to work the deposits in the Main Creek, and published some reports with its prospectus. One of these reports was by Mr. Thomas Kelly, who has worked on the field for many years, and the following is a copy of same, omitting purely commercial references:—

"I here submit my 20 years' practical knowledge of the field. The ground held by your syndicate is known as the Main Creek, embracing some 2 miles of the same; also some terrace ground at the head of the creek which is supposed to be the source of the shed of the gold into the valley of the Lisle. I have not the slightest doubt of the 2 miles of creek being payable; that is, by treating it on a large scale. There have been several syndicates formed, and the required capital subscribed, to work this same ground. They estimated that the tail-race would cost £5000, but when levels were taken they could not obtain sufficient fall to sluice the washaway. In my opinion the only way the ground can be treated is by dredging it. The richest of the veins were on the course of this Main Creek, and therefore wet claims to work, and when they are wet there is always a loss of gold. For instance, myself and party worked ground known as Donnelly and party's. We worked the claim out for a yield of over 2000 ozs. It being situated on the terrace we brought water on to it, and it was ground-sluiced away for a return of over 700 ozs. of gold; that made the yield of gold from four men's ground over 3000 ozs. As to the probable loss of gold in the Main Creek, there is no doubt they were mostly all rich claims, and I can safely put the loss down at one half of the return we obtained by ground-sluicing Donnelly and party's claim, say, 350 ozs.

* The present Main Creek used to be called Bessell's Creek.

to the acre. Your syndicate holds, say, 2 miles of the creek, and without a doubt there must be in the old ground alone, to say nothing of the solid blocks that have not been worked, some thousands of ounces of gold, as the diggers in the early days looked for 2 or 3 grains to the dish, and anything less was thrown away. Regarding the upper portion of your ground—that is what is known as the deep ground, which is supposed by many practical miners to contain the source of the gold which was worked in the Main Creek—there have been many parties formed to test it, but owing to the ground being too deep and wet they had to abandon it, so I cannot say much about it, only that the ground was payable up to it. This field was the richest alluvial field opened in Tasmania; the yield of gold settles that point. The return from here is roughly estimated at 300,000 ozs., and the greatest portion of it was obtained in the main creek and terraces on each side of the creek. The dirt is of a friable nature, easily treated; and the bottom is a decomposed or soft granite. The water the creek carries in the summer season is about 4 sluiceheads, in the winter months from 20 to 25 heads."

III.—PHYSIOGRAPHY.

Enclosed by high hills, Lisle is an upland valley, the floor of which is from a mile to a mile and a half in width. Its approximate height, according to aneroid readings, is between 700 and 800 feet above sea-level. The railway-station at Lisle-road is 341 feet above the sea, so that the Lisle township is about 400 feet above the railway line. For notes on the determination of heights, see appendix to this report.

The crests of the hill ranges on either side of the valley are about 3 miles apart east to west, and the valley is closed in at its head to the south by a broad divide 1200 feet above the township. On the southern side of this divide is the fall to the Scottsdale-road, and a couple of miles south-easterly the high land rises to the summit of Mt. Arthur, formerly called Row Tor, 3895 feet above sea-level. The two sides of the horseshoe thus formed flank the Lisle Valley as high narrow ridges, 800 to 1000 feet above the township. The eastern ridge separates the Lisle Valley from the deep basin of the Little Forester River, and the western ridge overlooks on the west the valley of the Lone Star Creek, and the head of the eastern branch of the Denison River.

The configuration of the valley shows that its age is considerable. The flat floor has been gradually widened and the steep sides pushed further and further apart. The north-easterly dip of the strata has contributed powerfully to the downward creep of the hill debris, which everywhere thickly covers the surface of the bed-rock and accumulates towards the foot of the hills on the east side of the basin in large terraces of angular stones. On the west side the terraces are not so numerous, owing to the different conditions caused by the dip there. The Main Creek hugs the base of the range on the eastern side, and Bessell's Creek does the same on the western side. Stony Creek and Thomas' Creek, which flow down from the western mountains, add to the volume of water carried off through the gorge. The ground is flat, and possibly at one time the rainfall was such that there was more water than could get away easily through the narrow outlet at the gorge. At present, notwithstanding the steep grade of the hills, floods are not complained of, and though the encircling ranges are chiefly narrow divides with small catchment areas, the rainfall as a rule is sufficient, though last summer, as elsewhere, was dry. There is no meteorological station here. The nearest are Scottsdale and Patersonia. The rainfall at Scottsdale, from 1st October, 1906, to 30th September, 1907, was 47.25 inches on 155 wet days. At Lisle it is probably in the nighbourhood of 40 inches. The clouds often pass over, following the mountain crests. Although, owing to the high hills surrounding Lisle, the winters are cold, the climate is milder than that prevailing on the south side of the divide, where the influence of Mt. Arthur and Mt. Barrow is more distinctly felt. Snow falls in the valley very seldom.

The prospector for reefs experiences great difficulty from the heavy overburden of surface debris which has slowly accumulated on the mountain slopes. I was shown one place up the hill where the granite bed-rock had been exposed in 3 feet of sinking, but a few chains away no bottom had been reached in 70 feet. This gradual uninterrupted process of accumulation interposes a serious bar to costeaning. That reefs of some sort are present in these hills is evident from the profusion of stones of quartz present in the terraces, which have been worked by the miners, and here and there barren veins are known, but the reefs which have shed the bulk of the unproductive stone found in the workings have not been uncovered

owing to the thickness of loose stony débris or clayey soil covering the surface.

The main reefing lines in the sandstone strata are likely to run more or less parallel with the north-westerly strike of the strata, consequently, roughly parallel with the long axis of the valley. The little creeks which flow into the Main Creek from the eastern side of the valley run over the granite zone, taking their rise for the most part near the junction of the granite and sandstone. Hence their value for intersecting reefs in the sandstone country is nil.

IV.—GEOLOGY.

The rocks which occur in the district fall into the two divisions of eruptives and sedimentaries.

(1.)—The Eruptive Rocks.

There are three groups or varieties of these, viz., granite, diabase, and basalt. Of these, the granite is the most important in every way, as the diabase and basalt have never been found in Tasmania to bear any relation to the process of deposition of the more valuable metalliferous ores or metals.

A.—*The Granite of the Lisle Valley.*

Below the alluvial of the creeks and the surface deposit of clay which covers the valley plain is the granite bed-rock. This is very generally concealed by the waste from the hills, but undoubtedly forms the solid floor of the valley and rises up the flanks of the mountains to a height of between 400 and 500 feet, when it junctions with Ordovician sandstone and slate. The exact line of the junction is hidden by the hill waste, but it is roughly traceable on the eastern side by the top of the granite forming a fringing shelf from which the sedimentary strata rise at a steeper angle of slope. The granite rises towards the south till it attains a height of about 700 feet, when it apparently passes under the divide in a south-easterly direction, reappearing, I am told, on one of Millwood's sections, and certainly exposed again beyond St. Patrick's River at Diddleum. The same belt comes to view again in Lone Star Creek and at Panama.

In the Lisle workings the granite is soft and decayed. At three places in the lower part of Main Creek loose boulders of the hard unaltered rock are seen in positions

which indicate the rising to surface of the solid granite mass. The rock itself is not dyke rock, but the normal granite of the belt. Higher up, at the head of the valley, on W. Kerr's land, is a knob of hard granite of the same type. At the north end of the valley, at the gorge, the granite sinks to the level of the creek, and disappears below the micaceous sandstone which forms the hill to the west.

To the naked eye it is of a finer grain than the familiar granite of the North-East Coast, and has a characteristic appearance, owing to dark magnesian mica (biotite) with some hornblende being present in great abundance. Quartz, though present, is subordinate. The type is the well known one of hornblende granitite. Rosenbusch defines granitite as follows:—*

"It is distinguished from granite, not only by the absence of muscovite, but is nearly always richer in lime-soda felspars, coloured constituents, and iron oxides, though on the other hand poorer in quartz than granite proper, in the restricted sense of the word . . . . The normal type of granitite takes up hornblende readily, and in this way the variety of hornblende granitite is formed (in petrographical literature often called syenite-granite)."

This rather basic, or, more strictly speaking, less acid variety of granite appears to be characteristically associated with gold rather than tin ore. The same type prevails all along the gold belt, at Diddleum, Lisle, Golconda, and where it is dominant it is safe to say that gold, and not tin, will be the metal that should be sought, as far as this part of the island is concerned. This is not affected by the circumstance that a little tin has been reported as found with the gold at Lisle.

B.—*Diabase.*

On the south divide, on T. Faulkner's (now A. Dean) 100 acres purchased land, and about 5 chains south of the north boundary, is a line of boulders indicating an outcrop of this rock running towards the west. It is the same rock as that which forms the summit of Mt. Arthur, consisting of a mixture of felspar and augite. The felspar is labradorite. The rock is of medium texture. It is too well known to need here a recapitulation of its microscopic characters. It intruded in the older sandstones and

* Mikroskopische Physiographie der massigen Gesteine, 1907, I. pp. 61-62.

the overlying Permo-Carboniferous strata, which latter have since been denuded, resulting in the exposure of the intrusive rock. Its age is approximately that of the close of the Mesozoic, consequently younger than the granite and older than the basalt. It is not connected in any way with the deposition of ore, and the only use apparently to which it can be put is in making foundations for buildings and bridges and metalling roads. For the former, it is strong and durable, but does not dress easily; and for the latter purpose it is not quite an ideal stone, being too tough to powder sufficiently to supply its own binding, and rather hard for horses' feet.

c.—*Basalt.*

In the eastern part of the preceding section and the one adjoining it on the south the rich soil of the farm land proclaims the presence of the basaltic lava sheet, 1800 feet above sea-level. This volcanic sheet is pretty well continuous to the south-east as far as and beyond St. Patrick's River, but it is often reduced to a thin covering of decayed rock or is even completely broken down into its characteristic soil. The ash cones of the Tertiary volcanoes have long since disappeared, and the former vents have not been located.

There are grounds for believing that in early Tertiary times the land in Northern Tasmania was even higher than it is now, but that a period of subsidence set in, which came to an end with the outpouring of the basalt lavas in the Middle Tertiary, since when an elevatory movement has taken place and the present Lisle Valley and gorge have been excavated.

The rock is the olivine-basalt, of which there appear to have been numerous outpourings in Tasmania at the close of the Lower Tertiary or Palaeogene period.

(2.)—The Sedimentary Rocks.

(1.) These consist of slate and sandstone strata, which have a very regular strike of N. 30° W., and a north-easterly dip. They are traceable without interruption to south-east of St. Patrick's River, and the prolongation of their bearing in a north-westerly direction would approximately follow the course of the Little Piper River. The same strike and dip continue as far as to the west of the Piper River and Back Creek, but there is a change of dip to the south-west within a few miles of Lefroy. As

a north-easterly dip prevails on the west side of the Tamar at Beaconsfield, that river is apparently either in a synclinal valley or, as is more probable, on the line of a fault which affects the older strata. In support of the latter theory is the negative fact of non-discovery on the east side of the river of any exposure of the Beaconsfield series.

The sandstone and slate strata form a belt on the east side of the Lisle Valley, while slate also skirts the west side. Another belt of slate comes in on the east on descending the range into the basin of the Little Forester. The sandstone and slate on the eastern ridge are metamorphosed to a hard, dark, bluish rock, with splintery and conchoidal fracture, and have been frequently mistaken for basalt. The rock has no doubt suffered from the granite contact. Where not altered, the sandstone is a soft brown micaceous rock. Another phase of alteration is also shown by the sandstone, which is slightly argillaceous, and under the microscope shows nodular segregations approaching the nature of incipient chiastolites.

Some obscure nodular forms are seen in sandstone to the west of the track on the top of the hill south of Lisle. It is rather doubtful whether these are organic.*

These stratified formations are with probable correctness placed in the Ordovician system. This conclusion is reached partly by the application of negative criteria and partly by connecting the stratigraphy with that of neighbouring belts of country. It has not been possible in Tasmania as yet to divide the Ordovician into Lower and Upper divisions.

(2.) Apart from the consolidated rocks is the heavy covering of hill débris and clay which clothes the hill slopes and is spread over the floor of the valley. This débris consists of angular and subangular stones of white quartz, sandstone, granite, chalcedony (from veins in the granite), and quartzite. The creeks contain waterworn stones of the same nature. There is some evidence of alluvial ground along the course of an older stream to the east of the present Main Creek on a higher parallel;† but there is no evidence of there ever having been any other drainage outlet to the valley than at the gorge end. There is a theory which is entertained by some on the

* The earlier reference to graptolites, found at Lisle by Mr. Thureau, may be disregarded as based on a misapprehension.

† This was in all likelihood the ancient bed of the present Main Creek.

field that a stream once passed north-west over or through the hill into the Lone Star Valley. I examined this divide, and came to the conclusion that no outlet could have existed in this direction. The dividing crest is solid sandstone, rising to 800 feet above the valley, and shows no indications of any alluvial covering which could mark a former channel.*

It is this unconsolidated mantle which has yielded all the gold which has been won from the field.

(2.)—*The Geological Sequence.*

This arranges itself as follows, reckoning from the earliest to the most recent places of the succession:—

(1) The deposition of the Ordovician sediments.
(2) The folding of these strata.
(3) The eruptions and consolidation of the granite.
(4) The period of the deposition of gold.
(5) The intrusion of the diabase.
(6) The outpouring of the basalt lava.
(7) Late Tertiary and recent sedimentation.

These periods cover the events which make up the geological history of Lisle so far as it can be deciphered from the rocks.

(1.)—*The Deposition of the Ordovician Sediments.*—This is the oldest geological process which we can here recognise. The more ancient rocks upon which these strata were laid down are nowhere exposed in the neighbourhood. The nearest reported occurrence of the older platform is near Glengarry, west of the Tamar, where crystalline mica schist indicates one of the Pre-Cambrian groups. The changes from sandstone to slate, and *vice versâ*, indicate frequent alternations of sediment from sand to clay when the Lisle beds were being formed.

The coast-line of this ancient sea is necessarily conjectural, but it may well have run along the Pre-Cambrian axis of what is now called the Asbestos Range, which stretches west of the Tamar all the way to Badger Head. How uncertain, nevertheless, such speculations are is exemplified by the microscopical examination of Ordovician slate at Mathinna, revealing, as it does, as constituents of the rock, minute fragments of granitic felspar,

* The comparatively recent cutting of the channel through the Gorge leads one to search for another outlet, and a north-westerly one is the only other direction which is reasonable. If any convincing evidence could be obtained, one would have to resort to this supposition.

evidently derived from the waste of granite ranges long since vanished without leaving a trace behind.

The Lisle belt of slate and sandstone continues south to the North Esk River (near which it encloses the Burns Creek reef), and beyond till it is interrupted by the Ben Lomond massif.

The Lefroy-Lisle Ordovicians differ in appearance from the Beaconsfield strata, which are perhaps somewhat older and do not seem to be represented to the east of the Tamar.

(2.)—*The Folding of the Ordovician Strata.*—The alternations of slate and sandstone in meridional belts and in directions parallel to the general laminations of the strata indicate that these partings as a rule conform with bedding-planes. Indications, however, are occasionally to be found showing the latter to be discordant and rather flat in places. These may be seen on the St. Patrick's River-road, past the post office, where the coarse partings of the slate, dipping steeply to the north-east, intersect almost horizontal bedding-lines. But whether the bedding is horizontal or inclined, the cleavage dips throughout are always at high angles. The change of dip between Lisle and the Tamar points to a great fold having occurred, and the anticlinal axis of this seems to be a little east of Lefroy. This is very likely responsible for the development of quartz reefs at that township.

The slaty cleavage is a regional feature, and results from the constituents of the original rock having been rearranged by earth-pressure. The period when this pressure was applied and the folding of the strata also took place has not been defined, but must have been between the close of the Ordovician and the beginning of the Permo-Carboniferous. As in other parts of the island rocks of Silurian age were involved in the process. The time was probably late Silurian or Devonian.

(3.)—*Irruption and Consolidation of the Granite.*—As has been remarked over and over again in our geological reports from Mr. A. Montgomery's time onwards, the granitic intrusions in Tasmania occurred between late Silurian and Permo-Carboniferous, and have generally been referred to the Devonian. Reference to this age will explain its presence in the Ordovician strata. It has invaded these in an axial line N.W.-S.E., through Panama and Golconda, Lisle, Diddleum, and so on, towards the North Esk. This line of outcrop lies several miles

west of the large granite mass in the Scottsdale district, of which it is probably a differentiated marginal portion. The two outcrops are of different types of granite, but are doubtless connected in depth. It is to be noted that the main mass consists of granite of medium acidity, while the outlying Lisle-Golconda exposure is distinctly more basic.*

After the invasion of the ancient sediments by the granitic magma at an undetermined but great depth, the elevation of the land, throughout a long period resulted in the erosion and removal of the superincumbent strata, exposing the underlying granite. In some parts of the country, *e.g.*, on the Blue Tier, Ben Lomond, and in the St. Paul's Valley, the granite was exposed already in Permo-Carboniferous times, for sediments of that system are noticed reposing on the granitic platform. At Lisle the wearing down of the overlying strata to granite level apparently took longer time.

The intrusion of the granite produced profound effects upon the surrounding strata—effects which are noticeable to a distance of several hundred feet from the known contact line. The adjoining slate has been silicified, and a good deal of mica has been developed in it, with a production of incipient chiastolitisation. The sandstone, too, has been converted into a highly micaceous quartzite. These metamorphosed rocks form an aureole surrounding the intrusive granite mass. Their alteration has proceeded so far as to effectually mask their real nature and to deceive the casual observer as to their original character.

(4.)—*The Period of the Deposition of Gold.*—Under this head I do not refer to the redistribution of gold which has taken place in the present Lisle Valley, but to the deposition or precipitation of the metal in the veins or other sources which have supplied the alluvial or quasi-alluvial of the diggings.

There is nothing to urge in favour of a theory that the present alluvial gold is a concentration of older alluvial gold belonging to the Ordovician sandstone. The fact

* See E. Weinschenk. Grundzüge der Gesteinskunde, 1907, II. p. 40.—"Granitic stocks often show that the core of the massif is composed of a two-mica granite, which gradually loses its muscovite contents in an outward direction. Biotite granite is thus formed, and to this hornblende is added: the plagioclase contents become more and more important and finally genuine plagioclase rocks, diorites, even gabbro, represent present facies of the granite."

that here and there some gold has been found in quartz veins shows that the Lisle gold must be referred to the granite magma. Consequently, wherever the gold appears along this line—Diddleum, Lisle, Golconda—granite appears also. There is a genetic relationship between the two. The formation of the one has been accompanied by the birth of the other. Whether, therefore, the gold was a primary constituent of the consolidated granite (of which there is no proof) or was deposited in veins either through the granite, or proceeding from it, or in solutions expelled from the granite magma, its approximate age is that of the granite, *i.e.*, Devonian. Its distribution through the unconsolidated formations which have been worked by the miners was effected long subsequently—in late Tertiary and Quaternary times.

(5.)—*The Intrusion of the Diabase.*—Although a few stones of diabase may be gathered in the soil of the valley, it is, strictly speaking, an outside rock, and certainly had nothing to do with the deposition of gold. Mt. Arthur and Mt. Barrow are crowned with it, and on their flanks are the Permo-Carboniferous fossil-bearing strata, which it has pierced, or between the beds of which it has forced its way. In either case the gradual erosion of the overlying measures has exposed the igneous rock on the present summits. The Mesozoic sandstones in this district seem to have been completely denuded, and thus proof is wanting here of the uppermost limit of the diabase, but elsewhere, wherever the upper coal measures survive, there is decided evidence of their penetration or disturbance by this igneous rock. Its intrusive character explains the widely different positions which it occupies in relation to the sedimentary strata in various parts of the island. In the south, section after section may be seen, showing it capped by the Permo-Carboniferous mudstones, while in the north, the relative position is reversed, and the summits of the mountains are occupied by the diabase.

As might be expected, its contact effects on contiguous strata are never extensive. A development of iron ore, calcite, or chalcedony in the strata passed through is frequently observed for a few feet from the contact. Shales at the contact are hardened into chert or adinole, and it is not certain that the opal occurrences at Bothwell are not due to the influence of this intrusive rock.

(6.)—*The Outpouring of the Basalt Lava.*—Although the basalt on the farms overlooking the Lisle Valley

reaches a height of 1800 feet above sea-level, it was probably much lower when it first flowed over the land. We know that at that time (Middle Tertiary) Northern Tasmania was undergoing a movement of slow subsidence, during which the Launceston Tertiary basin was filled with clay and sand sediment to the depth of 1000 feet, so that most likely the basalt which is now on the high divide was then flowing at somewhere near the level of the present Lisle township, or not far above it, for the subsequent elevation was perhaps not quite so great as the previous subsidence. There is no clear evidence that the basalt ever flowed over the ground which has been removed to form the Lisle Valley. It seems rather to have followed some depression of the surface towards the north-east in the direction of the Little Forester River.

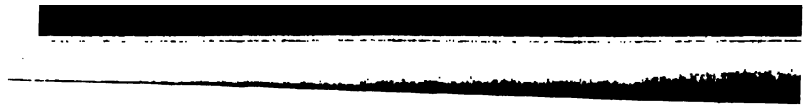
(7.)—*Late Tertiary and Recent Sedimentation.*—With the rising movement of the land after the lava flows alluded to above, the process of valley excavation at Lisle began, and has continued to the present day. The principal water-channel, with its tributary creeks, carved its channel deeper and deeper, cutting down through the sandstone and slate strata which once stretched right across the valley, and eventually laying bare and entering the granite foundation. This slow, resistless process has been at work for ages, assisted by rains and weather, breaking up the solid rock, releasing the quartz from veins, pounding it unceasingly to sand, draining off sand and water to the sea, collecting the residual gold. After Nature's slow, tireless toil, man appears on the scene, an army of miners descends upon the valley with box and cradle, and after a short period of feverish industry depletes the accumulated store of metallic residues and departs. The history of the invasion may be told in a few words.

V.—HISTORY.

The brothers Bessell discovered the field at the end of 1878, but it was not until January, 1879, that the rush took place. On the 11th January 14 ozs. of gold were brought to Launceston, and by the end of the month there were a hundred diggers on Main (then called Bessell's) Creek, working ground 4 to 10 feet deep, with 15 to 18 inches of wash-dirt. On the 12th of March His Excellency Governor Weld visited the spot and named the

LISLE VALLEY. [*Twelvetrees.*

LISLE VALLEY. [*Twelvetrees.*



township Lisle, in memory of the name of Mrs. Weld's family, which was De Lisle. By the end of that month a thousand men were working on claims extending for over a mile, and bringing in from £2 10s. to £15 per week per man. The reports of that year show that the population increased to 2500. The yields seem to have ranged from £4 to £12 per week per man for the most part. In some cases the highest figure exceeded this, while many only earned a living. By the end of 1879 the place had settled down to steady work. The reported yield of the field was then about 400 ozs. per week. The field was a very active one for three or four years, but after a rush which took place to Temora, N.S.W., work fell off considerably.

Mr. Charles Bessell has furnished me with much interesting information relating to the produce of the field in the early days. The best shows were:—(1) Donnelly's terrace (at these workings 1000 ozs. were got from 1000 loads). (2) Lockwood's terrace, where 600 ozs. were got in one year. (3) The Main Creek, all along which from £4 to £10 or £12 per week per man used to be made. The sides would yield an ounce per man, while the centre was much richer. A little to the west of the creek one man cleared £2500. In the creek opposite the post office 550 ozs. were won; and higher up the creek, at the Red Cliff, a couple of hundred ounces have been won from less than ¼-acre; and below this, 600 ozs. came from ground not exceeding ½-acre in extent.

The terraces were very rich in patches, Donnelly's being remarkably rich, but the creek was good all the way up, with hardly a "duffer" claim on it.

The total output of the field cannot be stated precisely, as only a small proportion of the gold won was sold in Tasmania. The Government returns show about 84,000 ozs., but there is reason to suppose that this is less than one-half of the real produce. Mr. C. Bessell, who took the trouble to obtain as many certificates from buyers as he could, and made numerous enquiries in reliable quarters, with a view of getting as near to the true yield as possible, is of opinion that it is in the neighbourhood of 250,000 ozs. Some have named still higher figures.

The present output as reported to the Mines Department is from 30 to 40 ozs. per month, but there is reason to believe that it is actually slightly in excess of this.

VI.—MINING.

The ground which has been worked, and some of it reworked, forms a belt of 500 or 600 feet in width along the Main Creek, and also a belt on the western side of the valley along Bessell's Creek. The tributary creeks have also been sluiced. The large terraces at the foot of the hills on each side of the valley have likewise been worked with great success. The occurrence of the gold seems to follow no regular rule, being sometimes distributed irregularly through the deposit from top to bottom, and in other places being won from a foot to 6 feet of wash lying on the soft granite bottom. The deepest ground on the creek is perhaps that near Langley's--16 feet. The ground forming the terraces is now spread out fan-like at the foot of the hills, and the small creeks have intersected it. Displacements of it have apparently occurred, and any tunnelling into the made ground is uncertain. Tertiary faulting is supposed to have taken place, disturbing the clay deposits, and interfering with some of the mining operations. The terrace stones are distinctly angular, and waterworn only in the bottom wash, while in the creeks they are rounded. A low ridge of soft granite separates the gold-bearing ground on the east side from that on the west side, and the miners say that they recognise differences in the appearance of the gold won from the different sides of the valley, and that the western gold realises about 10d. per ounce less than that from the eastern part of the field. The mint value of Lisle bullion is about £3 18s. per ounce.

The claims at present being worked on the field are as follows:--

(1) W. Kerr, in the upper part of Main Creek.
(2) Bailey's claim, also up the creek.
(3) Watts and Langley, under the cliff.
(4) Marshall and Faulkner, a little lower down.
(5) Marshall, also in the creek below the preceding.
(6) C. Bessell, in Main Creek.
(7) E. Bessell, in Main Creek.
(8) Jno. Kerr, in Main Creek.
(9) Watts' claim, in Donnelly's Creek.
(10) Watts Bros.', in Main Creek (lower part).
(11) Schlobohm, up Bessell's Creek.

(12) Lockwood's terrace, Harmansen's claim.

(13) H. Faulkner and Marshall, on Thomas' Creek.

These give employment to 23 men, all of whom are making a living, so that the field cannot be properly described as worked out.

Red Cliff.—The Cliff workings are in the part of the field where the old Mt. Arthur P.A. carried on exploratory work. It drove three tunnels into the eastern hill, where deep alluvial ground exists under a spur between two small creeks. Soft granite was driven through, and an east and west alluvial channel met with, filled with boulders and stones of quartz and sandstone. A little gold-bearing gravel was struck, but this cut out, and only broken barren material was passed through after this. The gold which was found is stated to have been angular, and with occasional pieces of quartz attached to it. The lead is supposed to have been dislocated and broken up by faults. However, this may be, extensive landslips have taken place on this slope of the range, and it is now difficult to locate the exact position of the original channel. This point is about 1½ mile up the creek from the gorge, and not much gold has been obtained higher up. The source of the Main Creek gold is therefore practically restricted to the eastern side of the Lisle Valley for 1½ mile in length.

At present the Cliff, or Red Face, is being worked by Watts and party, where there are about 10 feet of overburden overlying 4 feet of wash, which rests on the soft granite. The gold is not much water-worn, and is rather a coarse variety for Lisle. A flat piece, weighing 1 dwt., has been found recently, and several pieces weighing 6, 8, and 10 grains have been obtained. The ground is clean—not scaly; and has the reputation of being the best on the field. A few small sapphires and rubies have been found in the wash.

The most frequent stones in the dirt consist of the dark metamorphic and brown sandstone. Stones of chalcedony are fairly common, some of them containing pyrite. I was informed that a seam of pyrites was once found in the granite bottom; otherwise pyrites is absent. The iron-magnesia spinel (pleonaste), known on the field as black-jack, occurs in the wash, occasionally in large sizes. I saw a crystal of this embedded in vein quartz in Marshall and Faulkner's workings on the western side of the

valley. The gold obtained is free, but 2 or 3 grains have been found adherent to pieces of quartz of equal size.

J. Faulkner and Marshall.

A gully just north of the Red Face is being worked by Marshall and Faulkner. The ground consists of alluvial matter with stones of bluish and reddish sandstone. Large boulders of the bluish sandstone are scattered about the wash. Few stones of quartz occur. The wash of water-worn stones rests upon an irregular surface of granite, and has probably been the bed of the old Main Creek, which has gradually worked its way down to its present channel in the flat.

The ground has been worked up towards the head of the gully just below the track, where the last work done was four loads for 11 ozs., and then both gold and wash gave out. Towards the hill among the ferns there is deeper ground, 40 feet, and no bottom. Under Mr. A. Bessell's house the granite is even 70 feet below the surface. It is noteworthy that gold is obtainable here in the surface soil. Up the hill it can be got in the grass over a loose stratum of sand and stones 40 feet deep.

Callaghan's Creek.

The creek called Callaghan's flows into the Main Creek on this side of the valley, and has been worked for gold, but was not considered good ground. It was the highest payable alluvial at Lisle, and the best part of it was up near C. Bessell's house. The knob of ground there has gold at the surface, but this seems to cut out at that spot. Mr. C. Bessell states that it is the only place where he obtained some specimens of gold and quartz. The largest piece of quartz was the size of a pea, and had half a dozen little specks of gold in it.

Kelly's Creek.

Near the post office is another small creek, Kelly's by name, which has also been worked a little. It heads from a little distance up the hill, still in the granite zone.

C. Bessell.

A claim on the Main Creek opposite the township houses is worked by Mr. C. Bessell with fair results.

Cox's Creek.

Near the schoolhouse, Cox's, or Slaughteryard, Creek flows into the Main Creek. Its source is near the contact of the granite with the sandstone. Fairly good gold was won from its lower part, but the creek became poorer higher up. All round the valley is a kind of ledge which marks the upward limit of the granite. The drainage of the hill sinks through to this floor, and from it issue the head waters of the various creeks.

Donnelly's "Terrace."

Further north are Donnelly's Creek and Terrace workings. Close to the road is the rising granite bottom, a point of soft bed-rock on which T. Clare worked 4 feet of terrace for 1000 ozs. per 1000 loads. The old paddocks of terrace stone stretch up the hill to the east on the gently sloping granite floor to the 15 feet of standing terrace face, which has been tunnelled into at the base on the bed-rock. The top part of the terrace for 10 or 11 feet consists of clay and angular stones of reddish sandstone, highly micaceous and ferruginous. These have evidently crept down the hill as superficial detritus, and from their shape it is clear that they have not been moulded by river action. At the same time a certain linear arrangement of the stones seems to suggest that they formed part of shore-beds—perhaps on a lake beach. This rubble-bed passes downwards at one part of the face into a bottom layer of yellowish drift sand and clay 4 feet thick. This layer contains some rounded pebbles, and yielded the heaviest gold. At the same time prospects were obtained from the upper beds, and nearer the road gold was won from all through the deposit, which there consisted nearly entirely of surface clay, with scarcely any stone. I am informed that Donnelly's workings contained a good deal of chalcedony and quartz. The wash evidently had a distinctive character of its own.

Titmus Upper Tunnel.

The highest mining work on the field is that which was done at the Titmus upper tunnel above the Police Reserve and not very far below the crest of the hill. A shaft was sunk on a small leader in soft granite for 60 feet, and afterwards a tunnel was put in a little higher up, apparently on the same vein in sandstone. A good distance was driven without a trace of gold, and work was finally

suspended and the drive caved in. I picked up specimens of quartz at the approach, but these on crushing and washing proved to be quite barren. This tunnel is in sandstone country above the granite contact.

Titmus and Dodgshun's Tunnel.

A little lower down the hill Titmus and Dodgshan drove a tunnel 80 feet or thereabouts in soft granite. Mr. Montgomery reported in 1894 that there were five or six small auriferous veins, ¼ to ½ inch thick, of quartz and kaolin in the granite, coursing in a direction N. 76° E. Some of the quartz was sent to Launceston to be tested, and returned 3 dwts.

Lisle Dredging Company.

In the latter part of 1901 a Launceston company (the Lisle Dredging Company), commenced working the alluvial gravel in the Main Creek with a suction plant. The ground was estimated as worth 1s. per cubic yard, and the working costs as not over 6d. per yard. It was considered that as the old miners left all ground which yielded less than 5s. a yard, there would be ample margin for profit. However, the buried timber proved a great obstruction, and the number of times that the dredge had to be moved militated against cheap working. The ground, too, turned out to be nothing like so rich as was anticipated, and after three years' struggling with various hindrances—shortage of water, &c.—operations were suspended. The quantity of gold reported to the Government as won amounted to 1605 ozs.

Bessell's Creek.

At the north end of the field Mr. Schlobohm is working up Bessell's Creek. At this end the western and the eastern runs of gold-bearing drift seem to junction. Where Bessell's Creek joins the Main Creek a bar of granite crosses, and the best nuggets found in Lisle came from this locality. The largest one was discovered by T. Bessell, and weighed 15 dwts. The first one found is in the possession of Mr. W. F. Petterd, and weighs 1 dwt. 2½ grs. Several have been found weighing from 1 to 2 dwts.

Thomas' Creek.

Marshall and Faulkner have a 5-acre section (714G) in the western part of the field on Thomas' Creek, where

they are working a face by hydraulic sluicing. This terrace shows bedding lines and carries waterworn stones, suggesting former river action. Below the surface is red ironstone gravel for 4 feet, resting on 4 feet of sandy silt. Below this is a stratum of stones of quartz and grey sandstone for a foot in thickness, which rests upon 6 feet of clay and stones of slate. The whole deposit lies on granite bed-rock. In each bed there is gold, but the heaviest gold is on the bottom. The bottom wash contains pieces of granite and purple slate, and granitic mica is a constituent of the sand between the pebbles. The stones of blue metamorphic sandstone, so frequent in the deposits on the eastern side of the valley, are rarely found here. The extent of the auriferous ground has not been proved yet, but apparently its channel has proceeded from the hill to the south-west.

Further south a few colours are found in Stony Creek, and this does not suggest that there is much worth speaking of south of that creek.

Lockwood's Terrace.

North-west of Marshall and Faulkner's workings is the extensive patch of deep ground known by the name of Lockwood's Terrace. This is on a ridge which forms the end of a spur coming down from the western hills, and was worked in a good many places at one time, as many as 500 men being on the ground at one place or another. The deepest ground which has been bottomed is 60 feet. A shaft 60 feet deep was sunk, and 2 grains to the dish stated to have been prospected from the bottom. One, Currie, had a claim and puddled his dirt for 160 ozs., according to report. Lockwood's dirt, too, lower down, used to go 1 oz. to the load. Harmensen's face is 19 or 20 feet deep, with 4 feet of subsoil resting on 3 feet of horizontally bedded clay, which in its turn covers 12 feet of wash on granite bottom.

The drawback to the work on this terrace was want of water, and it is very probable that if water could be brought to it, the ground would still pay to work. The best gold, as usual, was found in the wash at the bottom; still, a little was obtained all through the deposit. Very little of the bluish metamorphic sandstone and slate is found here; the stones of quartz belong to a more kindly variety than that on the east side of the valley, and the gold apparently has not been derived from that side.

Mt. Arthur Properties, Ltd.

In this part of the valley several sections have been taken up by the Tasmanian Consols, Limited, on behalf of the new company, the Mt. Arthur Properties, Ltd., recently registered in London, with a capital of £65,000. A few preliminary bores have been put down in this ground to depths varying from 9 to 26 feet. Layers of heavy wash and boulders made it very awkward ground to test by boring. The holes were deflected, and in most instances the pump could not follow the auger. Notwithstanding this, gold was got in five out of the seven holes. Two holes gave 0·57 and 1·323 grains gold per cubic yard; two gave 1·728 and 2·16 grains; and one gave 8·748 grains per cubic yard. The testing work will shortly be resumed. The company contemplates working this flat, and as it is mostly virgin ground, the difficulties experienced by the Lisle Dredging Company in the worked ground along the Main Creek will probably not recur.

OBSIDIANITES.

Several of those interesting objects known as obsidianites (Australites) have been found in the wash at Lisle associated with the gold. Some recovered by Mr. Bessell were lying together on the granite bottom 17 feet from the surface. The forms known here are the circular button shapes, the dumb-bell shapes, and the beetle shapes. Some of these have been obtained from the gravel below the Red Face workings, so that we can say positively that they could not have travelled far; in fact, it would be possible to circumscribe an area a few hundred feet square within which they must have fallen. The proof of age is not precise, but it would certainly be Late Tertiary or Recent—not pre-basaltic. These obsidianites consist of acid or sub-acid volcanic glass, and not of such glass as would result from the emissions of any Tasmanian volcanoes. The proximity of the basalt sheet at Lisle is an accidental feature which is unrelated to the occurrence of these objects. It is sufficient to call to mind that they have also been found at Cox's Bight in the tin-bearing gravel in the extreme south-west of Tasmania, where there is no basalt whatever, the nearest being in the Huon basin. Their real origin is still a matter of debate, the theory which meets with most favour at present being that the glass is meteoritic.

VII.—THE DERIVATION OF THE GOLD.

Whence all the gold has been derived which has been won in the form of alluvial has long been a mystifying puzzle, baffling the prospector and the visiting expert alike. A quarter of a million ounces have been obtained from a mere fractional portion of an area not exceeding a mile and a half square. The bulk of this has been sluiced from the bed and banks of the Main Creek and from terraces sloping down to it on the eastern side of the valley; the remainder has been won from small creeks on the opposite side of the basin and from terraces above them.

The remarkable feature of the field is that no reefs have been found either in the valley itself or on the surrounding hills. Certainly some quartz veins must exist concealed beneath the mantle of overburden which clothes the hill-sides, because numerous stones of quartz occur in the drift; but this quartz is barren. No gold-bearing quartz has ever been seen in the workings, beyond a minute specimen here and there. Yet nearly everyone who works on the field or who prospects it has in his mind the eventual discovery of a parent reef or reefs which have shed the gold. A little reflection will show how unreasonable such a notion is. Anyone standing on the floor of the valley finds himself in a locked basin, walled all round by hills 800 feet to 1000 feet high, and cannot escape the conviction that whatever may be the source of the gold, the whole of it has been derived from points within the area upon which he gazes. The auriferous overburden which covers the bed-rock has not been brought by torrents from afar. The gold has not travelled. The terraces consist of hill detritus—not of shingly beds. Apart from the bottom wash of the terraces, the only shingle in the valley is that of the creeks or of their ancient beds. The creeks themselves are contained within the valley walls. With these conditions one cannot escape from the conclusion that if the gold has been shed from quartz reefs specimens of auriferous quartz will be found in the workings. But such quartz is absent, and the inference therefore is irresistible that the gold won must have been derived from some other source. This is the starting point from which any intelligent investigation of the phenomena must begin. There may possibly be a few gold-bearing veins in the surrounding hills, but any gold which they may have contributed must have been inconsiderable in amount, and they may certainly be neglected in this inquiry. A useful preliminary in the investigation will be to scrutinise closely

the nature of the stones with which the gold in the alluvial workings is associated, as from such scrutiny some definite information will certainly emerge.

I confine my remarks first of all to the eastern side of the valley, as the bulk of the gold has come from the Main Creek and the eastern terraces.

1. The stones in the alluvial and terrace ground are mainly metamorphosed sandstone and slate from the hill-side above the granite contact. The most abundant are bluish stones which bear a superficial resemblance to basalt. Some of them are quartzite or metamorphic sandstone; others, more compact in structure and of argillaceous nature, are altered slates. The rock has undergone intense metamorphism by reason of the influence of the intrusion of the granite. These stones contain a good deal of iron, and have a habit of crustal weathering which proceeds inwards till often only a kernel of the hard blue rock remains in the centre. The miners call this becoming coated with sandstone, and significantly state that it is characteristic of the deposits where gold is found. The importance of this statement will appear later.

Some reddish brown micaceous sandstone also appears in the detritus, and at Donnelly's terrace this is the almost exclusive component of the drift, the dark bluish variety being almost absent there. This is explained by the brown sandstone being *in sitû* on the hill above the terrace. The stones there are highly ferruginous and micaceous. Their mica may be considered as a result of the granite contact and the iron as derived from the decomposition of the ferro-magnesian mica.

The stones, therefore, which form the bulk of the gold-bearing drift have been derived, not from unaltered strata, but from rock which has been strongly modified by contact with intrusive granite.

2. Stones of chalcedony are frequent in the terraces, especially at certain points. A few of these stones picked up in the old workings under the Red Face contained dissseminations of cubical white iron pyrites.* The stones have probably been released from veins in the granite and along the granite contact line. Mr. C. Bessell many years ago drove a tunnel in the western hill to the contact line, which he found marked by a vein of chalcedony.

Many of these stones look as if they had been cut or chopped with a chisel on each side, while their substance

* These assayed in the Government Laboratories by Mr. G. Oliver Smith, Government Analyst, yielded a trace of gold.

was in a soft condition. The Germans call this "chopped quartz."* Such stones are common in the tin drifts in granite areas on the East Coast, and have given rise to a good deal of speculation as to their mode of origin. They probably represent veins in the granite, and the gashes are the moulds of crystals of felspar projecting inwards from the vein-walls.

No gold has ever been noticed in any of the stones of chalcedony met with in the workings.

3. The stones of granite which appear in the drift are infrequent. The granite bottom is invariably soft, and consequently it can hardly be expected that the alluvial will contain pieces of the hard rock. No reefs have ever been seen in the granite floor.

4. In places there are large stones of white barren quartz in the wash and detritus. These have not been traced to the veins from which they must have proceeded. It is surmised that such veins must exist in the sandstone. Small veins of quartz have been noticed here and there in the stratified rock, *e.g.*, at Titmus' upper tunnel, and on the western range, but these are unimportant and have no real bearing on the question.

The terraces on the western side of the field have evidently derived their gold from the hill on that side. The blue sandstone is not so common on that range, and the wash contains more slate. The same contact conditions prevail there, the granite bed-rock rising up the hill-side to junction with slate and sandstone.

Coming to the consideration of the derivation of the gold, it is quite possible that some of it may have come from soft pyritous or micaceous veins in the granite bottom, which have gradually worn away with progressive denudation. This, however, is pure hypothesis, and no proof is available. Some source, however, other than hard quartz veins must have existed.

An important clue to the solution of the problem is furnished by the discovery of visible gold in the dark metamorphic sandstone frequently referred to in this report. One of the rock specimens which I brought home showed distinct specks of gold free from gold or pyrite. Unfortunately, I have not been able to observe this in any other specimens, though I have broken hundreds of stones. However, the fact that gold is present in the sandstone is undoubted, and is sufficient to outweigh innumerable negative results.

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* Zerhackter Quarz.

The suggestion which I advance is that the bulk of the Lisle alluvial gold has been derived from the wasting away of the impregnated stratified rock near its contact with the granite.

Until we know more about the occurrence it is premature to attempt to range it definitely with other deposits, with which it may eventually prove to have little in common. We do not know yet whether the impregnations in the sandstone are connected with reefs proceeding from the granite, or whether a promiscuous deposition took place from siliceous solutions expelled from the granite during cooling, or some subsequent action took place along the contact line, distributing the gold in the adjoining rock.

In various parts of the world impregnations of gold in stratified rock have been recorded, but these seem always to be connected with quartz veins. One can only surmise that at Lisle the sandstone near its contact with the granite has been saturated with silica from the plutonic mass, and that the gold-bearing siliceous solution has deposited its precious freight in the interstices of the sandstone. The gradual weathering of the rock has liberated the gold, which, together with the detritus and wash (eluvial and alluvial) has found its way down hill to the terraces and creeks. All the facts and features of the field are in harmony with this view.

The impregnation may be irregular, and if so, it will not be easy to find the metalliferous patches. Even when found it does not follow that they will prove payable. The only way to test the occurrence is to remove the overburden on the hill-side and lay bare the bed-rock at the contact. The contact line from Donnelly's to behind Bessell's would be the most likely locality for this work. The task is not easy, as the overburden is heavy, and the position of the hidden line of junction has to be guessed at.

I took grab samples freely from the dark sandstone left in the paddocks from dredging and sluicing along the Main Creek, and these, assayed in the Government Laboratories by Mr. G. Oliver Smith, Government Analyst, yielded a trace of gold. Samples of the red ferruginous sandstone in Donnelly's terrace yielded nil.

VIII.—COUNTRY NORTH OF LISLE.

The Ordovician slate and sandstone continue north of the township to within a mile of the railway, when they are interrupted by granite. On the road opposite the Falls, in the Lisle Creek gorge, the dark metamorphosed

sandstone crops out, and on the west side of the gorge near the bar the brown sandstone is extremely micaceous, and has a microscopical structure resembling that of some of the crystalline schists—a structure which has been imposed upon it by the intrusion of the granite.

The general strike of the strata continues throughout the whole of this area, being for the most part about N. 30° W., though in some places up to N. 50° W., and the dip is uniformly in a north-easterly direction. In the bend of the road opposite F. Witte's house the bedding lines can be seen to be horizontal or slightly undulating.

Valentine Creek, which flows into the Little Forester River a mile south of the Lisle-road station, marks the junction of the slate and granite. On the north bank of the creek a surviving fragment of the ancient Little Forester River bed shows itself resting on granite at a good height above the existing river. On this granite ridge the schoolhouse is built, and it trends from that spot in a westerly direction. Northwards it sinks below alluvial gravels, which extend to the railway-line.

The granite is biotite-granite, of much the same type as that at Golconda and Lisle, and as it has also a mantle of slate and sandstone of similar age, its contact line ought to show indications of reefs or mineral deposits. I have not heard that it has been prospected very thoroughly.

Tobacco and Cradle Creeks.

Two miles north-west of Lisle, and on the southern boundary line of the Parish of Shaw, are some mining sections in which Tobacco and Cradle Creeks take their rise. These creeks flow north-east for nearly a mile and then unite, subsequently junctioning with the Lisle Creek. The sections can be reached from Golconda; they are not more than a mile south-east of the New Enterprise Mine. I visited them from Lisle, joining the Lone Star track on the crest of the hill west of Lisle Creek. Stringy-gum and sassafras clothe the side of the range, but at the top stringy-bark country is entered. Near the sections Middle Creek is crossed, a small stream flowing into Tobacco Creek and usually carrying about a sluicehead of water. No gold has been found in this creek.

Mr. C. Bessell discovered Tobacco Creek and gave it its name 18 months before he discovered Lisle. Cradle Creek owes its name to the work which was carried on in it. From these two creeks about 2000 ozs. of gold have been won.

I found an old prospector (Manson) in Tobacco Creek reworking old ground, with about 10 feet of clay overburden and 6 to 18 inches of wash resting on slate bottom. The stones of slate in the wash are angular, and the gold is not waterworn. When pieces of any size are found the gold is usually attached to quartz. The run of gold extends for nearly 20 chains, and has been worked up to the brow of the hill. It keeps at first to the creek, but finally leaves it and turns north-west up the hill. The gold in this creek is coarser than at Lisle, and nuggets up to 15 dwts have been found. The ground has been worked over three or four times, the workings widening each time. At the top of the hill which is between the two creeks a good deal of trenching has been done and some quartz veins have been found, one of which carried gold. A shaft was sunk on it for 25 feet, but the metal died out. A long tunnel was put in from the Cradle Creek side of the divide, but nothing was found past the entrance. On the summit of the ridge is an ironstone reef with a little quartz in it, very similar to many of those which occur near Lefroy. It appears to be conformable with the slate, and is not very promising to look at.

In the lower end of Cradle Creek the gold is extremely fine, and the wash is all quartz.

There seems to be no doubt that the gold won in the two creeks has been derived from the hill which divides them, and has been contained in quartz reefs. There was a rush here of 50 or 60 men some three or four years after work at Lisle began, and it is strange that the veins which shed the alluvial gold were not discovered. The area within which search has to be made is small, and it would seem that there is here a field in which a little capital might be usefully expended in exploration.

IX.—COUNTRY SOUTH OF LISLE.

The Ordovician strata of Lisle are prolonged south-east to Mt. Barrow and the North Esk River. Once removed from the immediate influence of the granite the slate becomes normally a grey greenish and purplish rock, with cleavage-planes having the usual north-westerly strike and north-easterly dip. Already at the head of the Lisle Valley the dark metamorphic slate and sandstone give way to purplish slate. From Faulkner's farm south-east to St. Patrick's River the stratified rocks are covered by a narrow strip of basalt and basaltic soil, which follows the

river down to Patersonia and further south to Mt. Edgecumbe and along Distillery Creek.

Several quartz reefs are known between Lisle and St. Patrick's River, but they are white and barren, and have been little prospected.

In the road below the St. Patrick's River post office a reef is exposed striking south-east and dipping north-east. It transgresses the country, and consists of seams of quartz alternating with chloritic and felspathic bands for a width of 1½ feet. It is a persistent reef, for it runs south a good distance on R. Wilson's land. On Warren's land are reefs or dykes of somewhat similar nature. Microscopical examination shows these decomposed greenish formations to be hornblende-granite dykes, and they no doubt have some connection with the hornblendic granite of Diddleum and Camden Plains.

Some boulders of granite porphyry apparently mark the line of a dyke or other granitic intrusion running north-east on J. Millwood's section, north-west of J. M. Peck's 100½ acres, across the river due west of the reefs just mentioned. These boulders are in slate country, but 10 chains south of them some Permo-Carboniferous mudstone with casts of spirifers is exposed on the road.

On Hart's 228 acres, on the road towards Sullivan's Bridge, is a wide red formation containing decomposed syenitic dyke-rock. The adjoining purple slate has here produced much red soil. No quartz is visible in the formation, but it is stained with manganese.

A little north is Brook's shaft, by the roadside. This was sunk 50 feet by a Launceston syndicate 10 years ago. Rumour says that assays of lead, gold, and silver were obtained. At present nothing can be seen beyond the grey slate thrown out of the shaft and a few stones of white vitreous-looking quartz mottled with specks of greenish slate and manganese oxide.

At Irishman's Gully, running into the basalt zone west of the St. Patrick's River, a little sluicing has been done and some gold obtained, but the quantity is not known. Above the junction of Patersonia Rivulet with the river, where the basalt crosses the former, some paddocks of dirt were opened out and some gold won. It is reported that some precious stones were found here. These were probably sapphires, as some have also been got at Camden Plains.

I did not go on to Camden Plains, which have long been known as a gold-bearing field. I am informed that there 9 to 10 feet of wash rests on the granite bottom. The

granite is hornblendic. The gold is excessively fine, and no nuggets are found.

Looking upon this district as a whole I do not anticipate that payable reefs will be found. I suspect that, as a rule, the gold which has been won in small quantities at different places has been shed from the lines of contact of the granite with the stratified rocks, and that though in the aggregate a fair quantity may have been liberated by denudation, it has been distributed by the drainage system over so wide an area that the concentrations of metal at the different points are not likely to be very remunerative.

There is, however, just a chance that some deposit a little above the average may be met with.

Mt. Barrow (4644 feet) is crowned with columnar diabase, and several hundred feet from its summit is fringed with sandstone and Permo-Carboniferous mudstone. The upper beds of the fringe consist of calceous mudstone charged with fossils, and the lower beds comprise sandstone and boulder conglomerate. also fossiliferous. These are about 1100 feet in thickness. They repose in horizontal layers upon the steeply inclined slate strata of the Ordovician system. Down in the St. Patrick's River Valley, at Maclaren's Turn-off, soft Permo-Carboniferous mudstone is again to be seen in the road drain.

A mile and a half further south, east of the main-road, is Bourke's sandstone quarry, with a cliff of freestone several chains long and 30 feet high. The stone is of even quality and grain, and free from iron. It looks as if it would make an excellent building stone. Samples may be seen at Mr. Silvanus Wilmot's stone-cutting yard, Brisbane-road, Launceston.

The diabase which surrounds Launceston plunges beneath the alluvial of the North Esk Valley and crops out in Mr. Fry's paddock on the Elphin-road. It passes below the Tertiary sandstone of the Windmill Hill and below the flat land at the junction of the North and South Esk Rivers. It has been found by boring at the Tamar-street Bridge 55 feet down. Processes of denudation have therefore in the course of ages removed the overlying Tertiary and Permo-Carboniferous strata, and have eaten into the diabase floor itself to a considerable extent. The thickness of the Launceston Tertiary beds may be gauged by the depth of the bore which was put down at Carr Villa—570 feet—before touching the diabase rock below. The old alluvial bottom began already to rise in later Tertiary times and with the new land configuration the North Esk River selected its present channel. The result

has been the formation of the Cataract Gorge, certainly not, as is often imagined, a display of volcanic energy, and probably not due to any disruptive force, but simply the carving out of a channel by the ceaseless but irresistible action of running water, assisted by a gradual elevation of the land.

W. H. TWELVETREES, Government Geologist.

Launceston, 10th October, 1908.

X.—APPENDIX.

ON THE DETERMINATION OF HEIGHTS.

The heights on this journey were taken with a 4-inch aneroid and a Casella's hypsometer. and to ensure an approximation to accuracy the calculations are based on readings taken during the last days of the period. It is now well known that aneroids give higher readings during the first few weeks of their stay at upper stations than they do subsequently. After a few weeks, if not used in further ascents, they recover and behave normally, probably increasing their index error in the process.

The results obtained with both of these instruments are inferior to observations taken with a mercurial barometer, but the transport of the latter is extremely inconvenient, requiring, as it does, continual attention and care. In fact, one man ought to be detailed to carry the barometer alone. The least inconvenient form is the portable mountain barometer made by several firms especially for explorers. For transport the cistern screw must be turned sufficiently to force the column of mercury to the top of the tube, and the instrument must then be carried upside down. While in this position loosen the screw half a turn so as to afford a little play to the mercury. If these precautions are not observed the instrument will come to grief. One cause of annoyance is that on mountain tops in a strong breeze the slender tripods supplied with the barometer vibrate unpleasantly and cause unsteadiness.

My boiling-point apparatus on this trip persisted in reading higher than the aneroid by 50 to 100 feet. I have generally used this method as a check on the aneroid with tolerably fair results. Of course it has been proved to be inferior in point of accuracy to the mercurial barometer, but nevertheless, on account of its convenience, it is much used by travellers. In using it, it should be borne in mind

that isolated observations are not of much value. At least three observations should be taken with different thermometers and the mean adopted. Thermometers, even by good makers, are not infallible, and as they increase in age they are apt to give too high temperatures, and consequently the calculated height is lower than the actual height. The value of one degree Fahrenheit on the thermometer tube in making the first ascent from sea-level is about 519 feet. It can therefore be readily seen what accuracy is requisite if fractional readings are to be reliable. Moreover, the value of the degree increases with the height above sea-level, so that instrumental errors and errors of observation ought to diminish as the ascent is made, which is not the case. Further, on looking through the literature of the subject, it does not appear at all certain that the barometric pressure corresponding with the various boiling-points has been accurately ascertained, and this adds a new source of possible error. In the earlier forms of the apparatus the purity or impurity of the water boiled affected the results, but in the hypsometers now obtainable, the thermometer, both stem and bulb, is immersed in pure vapour, so that the kind of water used is immaterial. For travellers' use, Casella publishes a set of tables, from which the following figures are taken:—

Boiling point temperature.	Approximate height above sea-level.	Difference for each degree.	Corresponding height of barometer.
degrees.	feet.	feet.	inches.
212	—	—	29·922
211	519*	519	29·335
210	1041	522	28·756
209	1566	525	28·185
208	2094	527	27·623
207	2623	529	27·070
206	3154	531	26·527
205	3686	533	25·993
204	4221	535	25·468
203	4757	536	24·952
202	5295	538	24·445
201	5834	540	23·946
200	6376	542	23·456

* Multipliers for the temperature of intermediate air and corrections for decrease of gravity as per tables given later in these notes must be used when the difference of height between two stations has to be calculated.

Aneroids.

There are many aneroids scattered about the country, and their possessors often suffer illusions in respect of their value for giving heights, and are, besides, inexperienced in their use for that purpose. The aneroid barometer cannot be called a tool of precision, notwithstanding various refinments of scale, verniers, &c. It is unreliable for contours of, say, less than 30 feet. Several unsatisfactory features are attached to its use, and great care has to be taken when employing it for the determination of heights. It is usual to hear travellers justify their determinations of mountain heights by laying emphasis on the fact that their aneroid needle has returned to its original base reading on the completion of their descent. This very fact would furnish grounds for suspicion, because the natural tendency of an aneroid in normal working order is during the ascent to lose or read higher than the true height, and in descending the opposite tendency or one towards recovery prevails. The two tendencies, as Mr. Whymper has shown, counteract each other, and the result is a retarded recovery, so that if a reading is taken immediately on completing the descent it will show less difference of air pressure than was shown by the ascent. Whymper states a rule: "All aneroids without exception lose upon the mercurial barometer when submitted to diminished pressure, and recover a portion of the previous loss when pressure is restored." He adds, that it is exceptional to find the loss exactly balanced by the recovery. The recovery is gradual, and sometimes exceeds the loss. Thus various index errors are acquired. A touching confidence is sometimes reposed in the Kew certificate when this is supplied with an instrument, but this is nothing more than a verification of the behaviour of the aneroid when under specific reductions of pressure in the maker's workshop. It is no guarantee of its behaviour during sustained fluctuations of pressure in the field. The certificate shows that care was taken in the manufacture, but the intrinsic foibles of ordinary aneroids remain unaffected. A clever and effective way of overcoming these disadvantages has been devised in the shape of the Watkin mountain aneroid, in which, by turning a screw at the back of the instrument, the pressure on the vacuum-box is exerted only at the time of taking the reading, and is relieved immediately afterwards.

Observers are advised not to rely upon readings at heights which are at all near the upward limit of the scale. Thus,

an aneroid graduated up to 5000 feet cannot be used with safety to determine heights above 4000 feet.

A gentle tap applied to the instrument is often of use in starting the needle, though the motion in walking or riding is usually sufficient to keep it acting freely.

It should be always read in one position, as the indicator will read differently according as the aneroid is held vertically or horizontally. The vertical position is preferable, as it can be suspended freely from the hand by the ring only, and exactly on a level with the eye.

In mountain climbing the pressure in inches should be noted, and not only the mere elevation scale, as the barmetrical pressure will have to be used in the subsequent calculations. The scale of feet, too, may be taken as being less accurate than the divisions for pressure.

Mr. Whymper prefers aneroids of large diameter to those of watch size. On the other hand, the topographers of the United States Geological Survey use instruments 2 inches to 2½ inches in diameter. My own experience has been favourable to the use of the smaller size, if of the best construction.

The reading should be taken immediately on reaching the summit of a mountain. The height observed will usually exceed the true height by a little. The excess will be found to have increased if another reading be taken a little later. The later reading should be neglected, for it is not the result of sluggish action of the needle, as has been supposed, but is due to the continued low pressure, as mentioned above.

The usual and proper use of the aneroid is in determining relative, not absolute, heights. If heights above sea-level are desired, it is necessary to select a base, or lower station, the height of which is known from other sources. A railway-station, or some point the height of which above the rails have been ascertained, may be chosen as a base. Every opportunity of checking readings by repeated observations should be taken advantage of, for aneroids often behave in an erratic manner, and single observations are unreliable.

If a second aneroid is not kept in camp and read throughout the day by a second observer, it will be necessary to obtain the 9 a.m. and 3 p.m. atmospheric pressure from Hobart or Launceston, and deduct or add the mean of the daily variation. Thus, if at Launceston the barometer reads at 9 a.m. 30·20, and at 3 p.m. 30·10, the mean variation will be ·05. Therefore, deduct ·05 from

the reading at field base in order to correct it for comparisons, say, at noon with the reading at the upper station.

To obtain correct temperature at upper and lower stations, use a standard mercurial thermometer made by a good firm. Shade temperature must be observed, and the thermometer should be suspended at least 10 feet away from any vertical rock face or cliff.

Some aneroids are furnished with attached thermometers which are supposed to show the temperature of the instrument, but good aneroids are commonly compensated for this, and the appendage is unnecessary.

In determining heights by aneroid in Tasmania two corrections must be applied to the reading, viz:—

Corrections—

1. Correction for difference of temperature between the lower and upper stations (See Table II.).
2. Correction for decrease of gravity due to height (See Table III.).

The use of these tables may be illustrated by the following example:—

9 a.m.		Launceston. Inches.	Lisle. Inches.		Launceston.	Lisle.
July 15.	Barom.	30·48	29·60	Thermom.	+ 39°	+ 32°
20.	„	29·50	28·75	„	+ 51°	+ 38°
21.	„	29·70	28·80	„	+ 46°	+ 34°
23.	„	30·08	29·15	„	+ 46°	+ 33°
25.	„	30·15	29·25	„	+ 33°	+ 28°
Average		29·11	29·98		+ 39°	+ 43°
						38°

Lisle.....	29·11 in.	Table I.	27,916·1 ft.
Launceston	29·98 in.	„	28,685·5 ft.
			769·4 ft.
Table II.	Mean temperature 38° =		1·0132 multiplied.
	769·4 × 1·0132 =		779 ft.
Table III.	Decrease of gravity.....		1·94 ft.
	Altitude of Lisle		780·94 ft.

Table I. must be used by extracting from it the difference of elevation in feet which it shows between the readings at the upper and lower stations.

If the precautions detailed in these notes are observed, aneroids, if of the best construction, will, subject to their natural limitations, give fairly satisfactory results.

TABLE I.—Guyot's Reductions of Barometric Readings to Feet. (From Smithsonian Miscellaneous Contributions.)

Barometer in inches.	Hundredths of an inch.										Barometer in inches.
	·00	·01	·02	·03	·04	·05	·06	·07	·08	·09	
24·0	22873·0	22883·9	22894·7	22905·6	22916·5	22927·4	22938·2	22949·1	22960·0	22970·8	24·0
24·1	22981·7	22992·5	23003·3	23014·2	23025·0	23035 8	23046·6	23057·5	23068·3	23079·1	24·1
24·2	23089 9	23100 7	23111·4	23122·2	23133·0	23143·8	23154·5	23165·3	23176·1	23186·8	24·2
24·3	23197 6	23208·3	23219 1	23229·8	23240·5	23251·3	23262·0	23272 7	23283·4	23294·2	24·3
24·4	23304 9	23315 6	23326·3	23337·0	23347·6	23358 3	23369·0	23379·7	23390·3	23401·0	24·4
24·5	23411·7	23422 3	23433 0	23443·7	23454·3	23464·9	23475·6	23486·2	23496·8	23507·4	24·5
24·6	23518·1	23528 7	23539·3	23549·9	23560·5	23571·1	23581·7	23592 3	23602·9	23613·5	24·6
24·7	23624·1	23634·6	23645·2	23655·8	23666·3	23676 9	23687 5	23698 0	23708·6	23719·1	24·7
24·8	23729·7	23740·2	23750·7	23761·2	23771·7	23782·3	23792·8	23803·3	23813·8	23824·3	24·8
24·9	23834·8	23845·3	23855·7	23866·2	23876·7	23887 2	23897·7	23908·2	23918·6	23929·1	24·9
25·0	23939·5	23949·9	23960·4	23970·8	23981 3	23991·7	24002·1	24012·5	24023·0	24033·4	25·0
25·1	24013 8	24054·2	24064·6	24075·0	24085·4	24095 7	24106·1	24116·5	24126·9	24137·2	25·1
25·2	24147·6	24158 0	24168·3	24178·7	24189·0	24199·4	24209·7	24220·1	24230·4	24240·8	25·2
25·3	24251·1	24261·4	24271·8	24282·1	24292·4	24302·7	24313·0	24323·3	24333·3	24343·9	25·3
25·4	24354·2	24364·5	24374·7	24385·0	24395·3	24405·5	24415·8	24436·1	24436·3	24446·6	25 4
25·5	24456·8	24467·0	24477·3	24487·5	24497 8	24508·0	24518·2	24528·4	24538·7	24548·9	25·5
25·6	24559·1	24569·3	24579·5	24589·7	24599·9	24610 0	24620·2	24630·4	24640·6	24650·7	25·6
25·7	24660·9	24671·1	24681·2	24691·4	24701 5	24711·7	24721·8	24732·0	24742·1	24752·3	25·7
25·8	24762·4	24772·5	24782·6	24792·8	24802·9	24813·0	24823·1	24833·2	24843·3	24853·4	25·8
25·9	24863·5	24873·6	24883·7	24893·7	24903·8	24913·9	24921·0	24934·0	24944·1	24944·1	25·9

26·0	24964·2	24974·2	24984·3	24994·3	25004·4	25014·4	25024·4	25034·4	25044·5	25054·5	26·0
26·1	25064·5	25074·5	25084·5	25094·5	25104·5	25114·5	25124·5	25134·5	25144·4	25154·4	26·1
26·2	25164·4	25174·4	25184·3	25194·3	25204·2	25214·2	25224·1	25234·1	25244·0	25254·0	26·2
26·3	25263·9	25273·8	25283·8	25293·7	25303·6	25313·5	25323·4	25333·3	25343·2	25353·1	26·3
26·4	25363·0	25372·9	25382·8	25392·7	25402·6	25412·4	24522·3	25432·2	25442·1	25451·9	26 4
26·5	25461·8	25471·7	25481·5	25491·4	25501·2	25511·0	25520·9	25530·7	25540·5	25550·4	26·5
26·6	25560·2	25570 0	25579·8	25589·7	25599·5	25609·3	25619·1	25628·9	25638·7	25648·5	26·6
26·7	25658·3	25688·1	25677·8	25687·6	25697·4	25707·1	25716·9	25726·7	25736·4	25746·2	26·7
26·8	25755·0	25765·6	25775·4	25785·1	25794·8	25804·6	25814·3	25824·0	25833·8	25843·5	26·8
26·9	25853·2	25862·9	25872·6	25882·2	25892·0	25901·7	25911·4	25921·1	25930·8	25940·5	26·9
27·0	25950 2	25959 9	25969·6	25979·2	25988·9	25998·6	26008·2	26017·9	26027·5	26037·2	27·0
27·1	26046 8	26056·5	26066·1	26075·7	26085·3	26095·0	26104·6	26114·2	26123·8	26133·4	27·1
27·2	26143 0	26152·6	26162·2	26171·8	26181·4	26191·0	26200·6	26210·2	26219·8	26229·3	27·2
27·3	26238 9	26248·0	26258·0	26267·6	26277·2	26286·7	26296·3	26305·8	26315·3	26324·9	27·3
27·4	26334·4	26344 0	26353·5	26363 0	26372·4	26382·1	26391·6	26401·1	26410·6	26420·1	27·4
27·5	26429·6	26439·1	26448·6	26458·1	26467·6	26477·1	26486·5	26496·0	26505·5	26514·9	27·5
27·6	26524·4	26533 9	26543·3	26552·8	26562·3	26571·7	26581·2	26590·6	26600·0	26609·5	27·6
27·7	26618·9	26628 4	26637·8	26647·2	26656·7	26666 1	26675·5	26684·9	26694·3	26703·7	27·7
27·8	26713·1	26722 5	26731·9	26741·3	26750·7	26760 1	26769·5	26778·8	26788·2	26797·6	27·8
27·9	26806·9	26816·3	26825·6	26835·0	26844·3	26853 7	26863·0	26872·3	26881·7	26891·0	2, 9
28·0	26900·4	26909·7	26919·0	26928·4	2693, ·7	26947·0	26956·3	26965 6	26975·0	26984·3	28·0
28·1	26993·6	27002·9	27012·2	27021·5	27030·7	27040 0	27049·3	27059·6	27067·8	27077·1	28·1
28·2	27086·4	27095·6	27104·9	27114·2	27123·4	27132 7	27141 9	27151·2	27160·4	27169·6	28·2
28·3	27178·9	27188·1	27197·3	27206·5	27215·7	27225·0	27234·2	27243·4	27252·6	27261·8	28·3
28·4	27271·0	27280·2	27289·4	27298·6	27307·8	27317 0	27326·2	27355·3	27344·5	27353·7	28·4
28·5	27362·0	27372·0	27381·2	27390·4	27399·5	27408·7	27417·8	27427·0	27436·1	27445·2	28·5
28·6	27454·4	27463·5	27472·6	27481·8	27490·9	27500 0	27509·1	27518·2	27527·4	27536·5	28·6
28·7	27545 4	27554·7	27563·8	27572·9	27582·7	27591·1	27600·2	27609·3	27618·3	27627·4	28·7
28·8	27636·5	27645·5	27654·6	27663·7	27672·7	27681·8	27690·8	27699·9	27708·9	27717·9	28·8
28·9	27727·0	27736·0	27745·1	27754·1	27763·1	27772·2	27781·2	27790·2	27799·2	27808·3	28·9

TABLE I.—Guyot's Reductions of Barometric Readings to Feet—continued.

Barometer in inches.	Hundredths of an inch.										Barometer in inches.
	·00	·01	·02	·03	·04	·05	·06	·07	·08	·09	
29·0	27817·2	27826·2	27835·2	27844·2	27853·2	27862·2	27871·2	27880·2	27889·1	27898·1	29·0
29·1	27907·1	27916·1	27925·0	27934·0	27943·0	27951·9	27960·9	27969·8	27978·8	27987·7	29·1
29·2	27996·7	28005·6	28014·6	28023·5	28032·4	28041·4	28050·3	28059·2	28068·2	28077·1	29·2
29·3	28086·0	28094·9	28103·8	28112·8	28121·7	28130·6	28139·5	28148·4	28157·3	28166·2	29·3
29·4	28175·1	28184·0	28192·9	28201·7	28210·6	28219·5	28228·4	28237·2	28246·1	28254·9	29·4
29·5	28263·8	28272·6	28281·5	28290·3	28299·2	28308·0	28316·9	28325·7	28334·5	28343·4	29·5
29·6	28352·2	28361·0	28369·8	28378·7	28387·5	28396·3	28405·1	28413·9	28422·7	28431·5	29·6
29·7	28440·3	28449·1	28457·9	28466·7	28475·4	28484·2	28493·0	28501·8	28510·6	28519·3	29·7
29·8	28528·1	28536·9	28545·6	28544·4	28563·2	28571·9	28580·7	28589·4	28598·2	28606·9	29·8
29·9	28615·7	28624·4	28633·2	28641·9	28650·6	28659·3	28668·1	28676·8	28685·2	28694·2	29·9
30·0	28702·9	28711·6	28720·3	28729·0	28837·7	28746·4	28755·1	28763 8	28772·5	28781·1	30·0
30·1	28789·8	28798·5	28807·2	28815·9	28824·5	28833·2	28841·9	28850·5	28859·2	28867·9	30·1
30·2	28876·5	28885·2	28893·8	28902·5	28911·1	28919·8	28928·4	28937·0	28945·7	28954·3	30·2
30·3	28962·9	28971·5	28980·1	28988·8	28997·4	29006 0	29014·6	29023·2	29031·7	29040·3	30·3
30·4	29048·9	29057·5	29066·1	29074·7	29083·3	29091·8	29100·4	29109·0	29117·6	29126·2	30·4
30·5	29134·7	29143·3	29151·9	29160·4	29169·0	29177 6	29186·1	29194·7	29203·2	29211·8	30·5
30·6	29220·3	29228·9	29237·4	29245·9	29254·4	29262 9	29271·5	29280·0	29288·5	29297·0	30·6
30·7	29305·5	29314·0	29322·5	29331·1	29339·6	29348·1	29356·6	29365·1	29373·5	29382·0	30·7
30·8	29390 5	29399·0	29407·5	29416·0	29424·4	29432 9	29441·4	29449·8	29458·3	29466·8	30·8
30·9	29475·2	29483·7	29492·1	29500·6	29509·0	29517·5	29525·9	29534·3	29542·8	29551·2	30·9

TABLE II.—Multipliers for Temperature of Intermediate Air.

Mean Temperature of Intermediate Air.	Multiplier	Mean Temperature of Intermediate Air.	Multiplier.	Mean Temperature of Intermediate Air.	Multiplier.
32°	1·0000	55°	1·0511	78°	1·1022
33°	1·0022	56°	1·0533	79°	1·1044
34°	1·0044	57°	1·0555	80°	1·1066
35°	1·0066	58°	1·0577	81°	1·1088
36°	1·0088	59°	1·0599	82°	1·1111
37°	1·0110	60°	1·0622	83°	1·1133
38°	1·0133	61°	1·0644	84°	1·1155
39°	1·0155	62°	1·0666	85°	1·1177
40°	1·0177	63°	1·0688	86°	1·1199
41°	1·0199	64°	1·0711	87°	1·1222
42°	1·0222	65°	1·0733	88°	1·1244
43°	1·0244	66°	1·0755	89°	1·1266
44°	1·0266	67°	1·0777	90°	1·1288
45°	1·0288	68°	1·0799	91°	1·1311
46°	1·0311	69°	1·0822	92°	1·1333
47°	1·0333	70°	1·0844	93°	1·1355
48°	1·0355	71°	1·0866	94°	1·1377
49°	1·0377	72°	1·0888	95°	1·1399
50°	1·0399	73°	1·0911	96°	1·1422
51°	1·0422	74°	1·0933	97°	1·1444
52°	1·0444	75°	1·0955	98°	1·1466
53°	1·0466	76°	1·0977	99°	1·1488
54°	1·0488	77°	1·0999	100°	1·1511

TABLE III.—Correction for the Decrease of Gravity on a Vertical acting on the Density of the Air. This correction must be added:—

(From Smithsonian Miscellaneous Contributions.)

Approximate Difference of Level.	Decrease of Gravity. Positive.	
	0	+ 500
Feet.	Feet.	Feet.
1000	2·5	3·9
2000	5·2	6·6
3000	7·9	9·3
4000	10·8	12·2
5000	13·7	15·2
6000	16·7	18·3
7000	19·9	21·5
8000	23·1	24·7
9000	26·4	28·1
10,000	29·8	31·5

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